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### THE HUMAN UTERINE MUCOUS MEMBRANE DURING MENSTRUATION\*†

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#### PART I. INVOLUTION AND VARIABILITY

SOME seven years ago Carey Culbertson and I laid plans for testing the endometrioma hypothesis of Sampson by applying cytologic methods to the study of such tumors. This necessarily involved a comparison of the internal organs of tumor cells with those of the normal elements of the uterine mucous membrane. A survey of the literature showed that no real cytologic study had been made on any mammal and so it was necessary to study first the changes in the nuclei, mitochondria, Golgi apparatus, etc., of normal cells during the entire menstrual cycle. Incidentally various statements were found in the literature which required checking up. The most astonishing concern the vascular supply, which ought surely to have received careful attention considering the great importance of that fundamentally vascular phenomenon, menstruation. No one has ever followed the vascular changes with reference to the cycle, yet the differentiation between the various types of bleeding and especially the understanding of the factors which control menstrual bleeding depend upon such a study. Our knowledge of the blood vessels of the uterus during the period of the flow is derived entirely from the study of fixed material and very little is known of the effects of fixing agents upon

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\*From the Hull Anatomical Laboratory, the University of Chicago, based on the collection of Dr. Carey Culbertson.

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blood vessels. Adequately preserved menstruating uteri are so rare that there are no satisfactory descriptions or figures of the associated rhexis and diapedesis. So far as the lymphatic vessels are concerned, we do not have as yet a conclusive demonstration of their presence in the mucous membrane at any stage of the cycle.

The entire body of uterine research is small in comparison to the wealth of histologic and physiologic work, human and comparative, that has contributed to our understanding of other viscera and glands. The reasons for this are not far to seek. The reproductive system is usually the first to show abnormalities in animals under laboratory conditions. In order to understand the uterus, it is necessary to study a large number of normal organs seriated with reference to an external sign and removed at definite times in the sex cycle. The changes must be correlated with the ovarian changes. The various species of mammals differ in the details of the cyclic changes for many are correlated with mating behavior and placentation; the latter process has reached the height of diversification among mammals. One cannot therefore, without great care, carry over the observations made on one species to another. So far as the human cycle is concerned, detailed comparisons are possible only with other primates, for the function of menstruation is confined to this order. Monkeys are costly and until recently it has not been possible to keep them normal in the laboratory. Consequently the bulk of our knowledge concerning the uterus has been contributed by practicing gynecologists and obstetricians on the basis of material from the clinic. Certainly no group of specialists has a keener or more general interest in the fundamental problems of its subject and what little work they have done is good. But the methods that have been employed have necessarily been of a routine character, and with three exceptions, limited in number. Only two accounts of a gross study of the living uterine mucous membrane have been published (Schroeder, Hinricks and Kessler, 1926, and Markee, 1929). No one has made comparisons between fresh cells and those in histologic preparations, although, from the histophysiologic point of view this is essential. Studies on the secretions leave much to be desired; it is an especially great handicap that the difficulties of collecting secretion in quantities for chemical study seem insuperable in most cases. The physiologists have not contributed much; the necessity of controlling every experiment by a careful study of histologic preparations has deterred most of them from entering the field. The chief advances on the comparative side have been made by zoologists like Heape and F. H. A. Marshall and by American anatomists who have followed the trail in physiologic histology blazed by Mall and Bensley. In the work that has been done most of the effort has been concentrated on finding criteria for certain stages of the cycle and no exhaustive histologic studies have been

made. In brief it may be said that in no mammal has the uterus been studied with sufficient thoroughness or with all the resources of modern histology for elucidating its functions.

During the past six years we have obtained 315 uteri, most of them from Dr. Culbertson's clinic. The majority he dropped into fixing fluid as soon as he had removed them;\* we prepared a series of uteri for cytologic study by fixing blocks from the same specimen in six or more different fluids, from three to ten minutes after they had been removed. In certain cases a study of fresh tissue in normal saline solution was made with the aid of immersion lenses.

At this time I wish to report only on some findings from the least known phase, namely, the period of the flow. There are two reasons for doing this in advance of the presentation of the general cytologic study, first because certain recent observations on the physiology and histology of the female reproductive system have necessitated a modification of the current theories of the cycle and second, because the variability in our own material cannot be fully explained on the basis of the best substantiated theory we have at the present time, *viz.*, the theory of the human menstrual cycle which has been developed during the last twenty years largely by Robert Meyer and R. Schroeder on the foundations laid by Bischoff, Hitschmann and Adler, L. Fränkel, and others. It may be summarized as follows:

While the uterine mucous membrane is reorganizing after a menstrual flow, a graafian follicle begins to grow and the uterine mucous membrane rapidly thickens. Typically, ovulation occurs during the second week after the beginning of a flow (cf. Allen et al., 1928). The subsequent development and physiologic activity of the corpus luteum are associated with a hyperemia and often an edema of the mucous membrane, together with an enlargement of the component cells,† which has, by the beginning of the fourth week of the cycle, reached the condition usually termed "premenstrual."‡ If the ovum has not been fertilized, the corpus luteum degenerates and menstruation ensues. This has become so important a feature of the theory that R.

\*We are also indebted to him for the pathologic diagnoses and for obtaining as complete and accurate menstrual histories as possible. I owe much to Dr. R. R. Bensley for inspiration and criticism. Dr. J. L. O'Leary and Miss C. M. Bensley have given me invaluable help in the course of the work; the latter is responsible for the data concerning glycogen. Case XV was obtained through the kindness of Dr. H. O. Jones.

†Dr. O'Leary has under way a detailed statistical study of this matter and of the nucleocytoplasmic ratios in the gland cells during the various phases of the cycle.

‡Since this is exactly the condition found in the decidua vera of the earliest normal implantation stages, as for example the Kleinhans ovum of Grosser (1922) and the Miller ovum (Streeter, 1926), it may be called "pseudopregnant" following Hill and O'Donoghue (1913). This term has been adopted by those who are familiar with the conditions in marsupials where pseudopregnancy is most strikingly manifested. R. Meyer (1924) has objected to the term "premenstrual" for, as he says, it is equivalent to saying that a student takes a course of study in order to fail in the final examination. He has proposed the term "pregraavid." This does not emphasize the fact that the changes in the entire reproductive system are practically and perhaps exactly the same during the first two weeks after ovulation, whether fertilization occurs or not. Corner's (1927) term "progravid" is more euphonious than "pseudopregnant" and also expresses the generally recognized adaptive character of the condition. When one wishes to use a noun, "pseudopregnancy" is the best term we have.

Meyer (1924) has not hesitated to say that there can be no true menstruation except following ovulation and corpus luteum formation. The emphasis on this phase of the theory is a sequel to the fundamental postulate that the periodic growth and ripening of graafian follicles are the prime movers in the recurrent cycles of the mammalian female reproductive apparatus. This has been taken for granted ever since Bischoff's monumental studies (1842 to 1854). As details have accumulated since then, and as more species have been studied, it has become increasingly obvious that the fundamental physiology of the cycles is the same in all mammals (cf. Hartman, 1929) and until very recently no objections have been raised to Bischoff's general theory. In 1926, however, Parkes reported the occurrence of successive and typical estrus cycles (including mating behavior) in mice which had been sterilized with x-rays, some before and others after reaching sexual maturity. Brambell, Parkes and Fielding (1927) described the characteristic changes associated with estrus in the uterus and vagina of such sterilized mice. The ovaries contained nothing resembling a normal follicle. They found that eventually the bulk of the ovary consisted of embryonic cells proliferated from the germinal epithelium which had replaced the degenerated follicles and which, so far as they could see, showed no evidences of cyclic change; nevertheless, the cycles promptly ceased after double ovariectomy as they did in cases where the proliferated tissue underwent degeneration. Its origin is the same as that of the follicular epithelium; the two tissues would seem to be related physiologically as well (Parkes, 1929). These observations, which have been confirmed by Zondek and Aschheim (1927), demonstrate that in the mouse, the estrus cycles are independent of the growth and maturation of ovarian follicles. We may assume that the rhythm is controlled by the same mechanism in all mammals; we must at least hunt for this control outside of the ovary. While the ovary is undoubtedly a necessary link in this mechanism, for without it the genital tract soon atrophies, yet the control may well be located elsewhere. Moore (1930) has presented a stimulating hypothesis in this connection which explains a wealth of evidence for an alternation of ovarian and hypophyseal activity.

There is also certain evidence from the primate cycle which necessitates a modification of the theory outlined above. The most obvious feature of this cycle is menstruation. It has been shown that in various of the higher monkeys there may be periodic bleedings from the uterus, clinically indistinguishable from menstruation, which occur in the absence of large follicles or corpora lutea. This was first described by Heape (1894 and 1897), and confirmed by van Herwerden (1906); the conclusive evidence was first obtained by Corner (1923 and 1927) who was in a position to appreciate its significance fully. He has been able to show that in the Macaque, ovulation is followed by



a typical pseudopregnancy and in the absence of fertilization, menstruation ensues. This is in full agreement with the theory. However, menstruation may occur at the expected time although an exploratory laparotomy done one to two weeks previously showed no evidence of a corpus luteum or a large follicle. In these cases autopsy revealed no sign of large follicles or recent corpora lutea and also proved the animals normal. Under these conditions then, there is bleeding from an "interval" mucous membrane, associated with some loss of tissue. This is not due to the abnormal environment of the laboratory for such menstruation was described by van Herwerden in monkeys shot in the jungle. She explained it as characteristic of the sexually inactive period (cf. Hartman, 1930). The reason she did not ascribe it to the absence of a preceding ovulation was that she found four menstruating uteri which showed no evidence of a pseudopregnant hypertrophy of glands or arterioles, although a corpus luteum was present in each case. No adequate evidence was presented, however, that any of these four corpora belonged to the last cycle previous to the killing. Corner's findings on *Macacus rhesus* have been confirmed by Allen (1926 and 1927), by Hartman (1927), Joachimovitz (1928), and we have observed a similar case.

These observations on other primates become particularly significant in the light of the evidence that menstrual bleeding may occur at the expected time in women although there has been no preceding ovulation. Corner (1927) has cited several cases from the literature in which the evidence was convincing.

I can add another from Bischoff (1854, Case xiv) who gives the available data in full so that an interpretation can be made in the light of our present knowledge. He found blood in the uterus and vagina of a young woman who had drowned herself on the fifth day after the beginning of a period, but the uterine mucous membrane was not hypertrophied as in his other cases of menstruation. While this was hardly to be expected on the fifth day, yet there was no large follicle or a recent corpus luteum in either ovary. Those who are familiar with Bischoff's papers will not question the accuracy of his observation. Although there was the testimony of the girl's roommate that her periods were regular and that she had actually menstruated at the expected time, Bischoff did not regard the case as sufficient to overthrow his theory because the girl's mistress was convinced that the last menstruation was feigned in order to conceal a pregnancy. There was, of course, as Bischoff says, no sign of pregnancy. This would now appear to have been a case of that type of menstruation which usually occurs in monkeys outside of the breeding season and may occur at other times.

Two of the human cases cited by Corner agree with this one in all essential features. In most reported human cases of menstruation without preceding ovulation, one or more large graafian follicles were present and this was taken at the time as proof of the coincidence of ovulation and menstruation. We now have reason to believe that large follicles found at the time of menstruation are atretic. They may, nevertheless, be associated with pseudopregnant development of

the uterus, as was first described by Leopold (1877, Case 1) and conclusively proved by Stieve (1926) who studied the material from a panhysterectomy done on the twenty-third day of the cycle. In this case the histology of the uterus was typically "progravid" but instead of a corpus luteum, he found only a 14.8 mm. graafian follicle containing an ovum with the first maturation spindle. This state of affairs might be interpreted as meaning that the mature or early atretic follicle has similar effects on the uterine mucous membrane as the corpus luteum. There are doubtless differences but what they are we have yet to discover. At all events the finding of pseudopregnancy in a human uterus cannot be taken to prove that ovulation has preceded this state, although that is undoubtedly the ideal situation. It may be that occasionally an over-ripe follicle is induced to rupture late in the cycle and this might explain the abnormal development of such ova as Bryce-Teacher I and Möllendorff "Sch." Certain it is that when a large follicle is present in the ovary late in the cycle, the uterine mucous membrane does not present the picture of hyperplasia which is frequently associated with "small cystic degeneration" of the ovary. There is good evidence that extracts of the corpus luteum produce effects which cannot be obtained with the follicular hormone (Hisaw et al., 1927, Corner and Allen, 1929, Van Dyke and Gustavson, 1929), at least in certain mammals. Since one or more large cystic follicles are found so frequently in human ovaries removed during the second half of the cycle, especially when there is no corpus luteum, we can understand why menstruation from an "interval" mucous membrane is so rare in this species. The uterus removed on the third day which was figured by Palmer Findley (1902) may be such an one; unfortunately, neither clinical data nor a description of the ovaries was given in this case.

While we may say that ovulation and corpus luteum formation associated with progravid development of the uterine mucous membrane, *typically* precede menstruation in women, yet the exceptions prove that the theoretic deductions drawn from this association are not justifiable. The mechanism is not a rigid machine which will not work if the gears do not all engage. Specifically, the vascular changes of menstruation are loosely correlated with the ovary and pseudopregnancy and they may occur in the absence of the latter. Conversely, as we shall show below, it is probable that ovarian hormones may continue to stimulate the mucous membrane after bleeding and the resulting degeneration have begun (cf. p. 640).

#### MATERIAL

The majority of the Culbertson specimens are uteri removed because of fibromyoma or fibrosis uteri, or come from defundations done in cases of pelvic peritonitis following salpingitis. Practically all speci-

mens were removed by the abdominal route and with care to prevent trauma. In the entire collection there are 33 cases removed during the second half of the cycle, which have either a normal mucous membrane or one with *normal areas*. In 12 of these, a recent corpus luteum was also obtained. All of them show a degree of pro gravid change corresponding more or less closely to the theoretically expected stage. We have others removed sixteen days or more after a flow which show little or no evidence of pseudopregnancy, but as R. Meyer (1924) has pointed out, these can always be explained as coming from amenorrheic phases, so that they cannot give evidence regarding cycles without ovulation. From the period of bleeding, we have 21 specimens, 14 of which can be regarded as normal on the basis of their histologic appearance and clinical histories. There are 6 cases from the first day, 3 from the second, 2 from the third, 2 from the fourth, and 1 fifth day case. Since different regions of the same specimen show different stages of the process of menstruation, the material is not so meager as may appear at first sight. All our menstruating specimens, but two, show evidence of having been pro gravid during the preceding cycle; in 3 of them corpora lutea were obtained which belong to that cycle; 9 have histologic evidence in the mucous membrane of an antecedent pseudopregnancy.

The total number of menstruating uteri which have been studied histologically since Kundrat and Englemann (1873) is still so small that no one can be justified in setting up a norm for the process. We need a large series of detailed descriptions, generously illustrated, of individual selected cases so that in time a sufficient number may be accumulated to serve as a basis for an account of the normal variability on the different days of bleeding. Lack of space prevents such detailed accounts of our specimens at this time.

The present study has thrown new light on several phases of the menstrual process. At this time we shall present some evidence as to the extent of the tissue loss and on the variability found in the same and in different uteri.

#### INVOLUTION AND THE EXTENT OF TISSUE LOSS

The old problem concerning the loss of tissue during menstruation can be regarded as settled. Schroeder (1913-1928) has concluded that the entire compact and spongy strata are lost during the flow. Sekiba (1923), who studied sections of uterine mucous membrane obtained by placing a cap pessary over the portio vaginalis as well as sections from 14 uteri removed during menstruation, concluded that the stratum compactum and only a part of the spongiosum were lost. Novak and TeLinde (1924), after a study of 12 selected cases of patients who were operated upon during menstruation, supported Schroeder's contention that the entire spongy layer had been lost by the third day. They

removed the organs with the greatest care to meet the objection that the manipulation during the operation might be responsible for much of the tissue loss. Froboese (1924) emphasized the individual variability in the amount of tissue lost while Shaw (1926) was inclined to believe that all of the spongy zone is shed. The possibility still remains that the regular pelvic examination of the patient in late progravid stages may influence conditions\* observed during menstruation. Until we have a large series of uteri fixed promptly enough to avoid postmortem changes from women with normal pelvis (accident or sterilization cases), where, in addition, the bleeding can be established as an expected flow, we shall not be in a position to speak with certainty concerning the normal range of variability; i.e., to establish a norm for the process of menstruation. At present there are not even enough normal specimens to fully evaluate the possible effects of pelvic disease. In the interim we must rely for controls upon studies of other primates such as those of Heape (1894 and 1897), van Herwerden (1906), Joachimovitz (1928), and notably Corner (1923 and 1927) who alone has had adequate menstrual records.

Sekiba's conclusions regarding tissue loss have been challenged from Schroeder's laboratory by Bohnen (1927) who pointed out that the early desquamatory phase, which may result in a relatively slight loss, is followed by a crumbling away of the surface, cell by cell, a process particularly emphasized by Novak and TeLinde. Bohnen alone has appreciated the need of a landmark for determining the extent of tissue loss, for, as he says, the thickness of the mucous membrane is too variable for measurements to be of any value in this connection. He used as a landmark the spiral arterioles which in sections often appear as a group of transversely and obliquely cut vessels and which he terms "vascular fields." He believed these to be confined to the basal zone and when he found them at the surface of the mucous membrane in late stages of menstruation, he concluded that the entire overlying spongy zone had been lost. It will be remembered, however, that Leopold (1877) described spiral arterioles near the surface. In serial sections the vascular fields are seen to extend far up into the "functional" zone, both in progravid stages (Fig. 6) and in such menstrual stages as still have most of the stratum spongiosum intact. The arterioles then only give us evidence that some stratum spongiosum is lost. We need some reliable landmark, for it is undoubtedly true that ordinary sections of late menstrual stages present a superficial resemblance to the stratum basale of progravid stages. This has no significance because of the extensive involution at the beginning of a period, the significance of which I have pointed out (1928 American

\*Schroeder has attributed to the preceding bimanual examination the extravasation of blood which is almost always to be found somewhere in the mucous membrane of uteri removed at operation, irrespective of the phase of the cycle. This matter deserves further study.

Anatomical Meeting). We must consider this problem before it is possible to discuss the question of the extent of tissue loss.

*Involution.*—Recent writers in presenting the evidence for tissue loss seem to have forgotten the menstrual involution, upon which the older writers placed so much emphasis. In his latest presentation, Schroeder (1928) does not even mention it, yet if one studies his figures 67 and 68 critically it is obvious that the great difference in thickness between them is not due primarily to loss of tissue (cf. Fig. 1). No one appears to

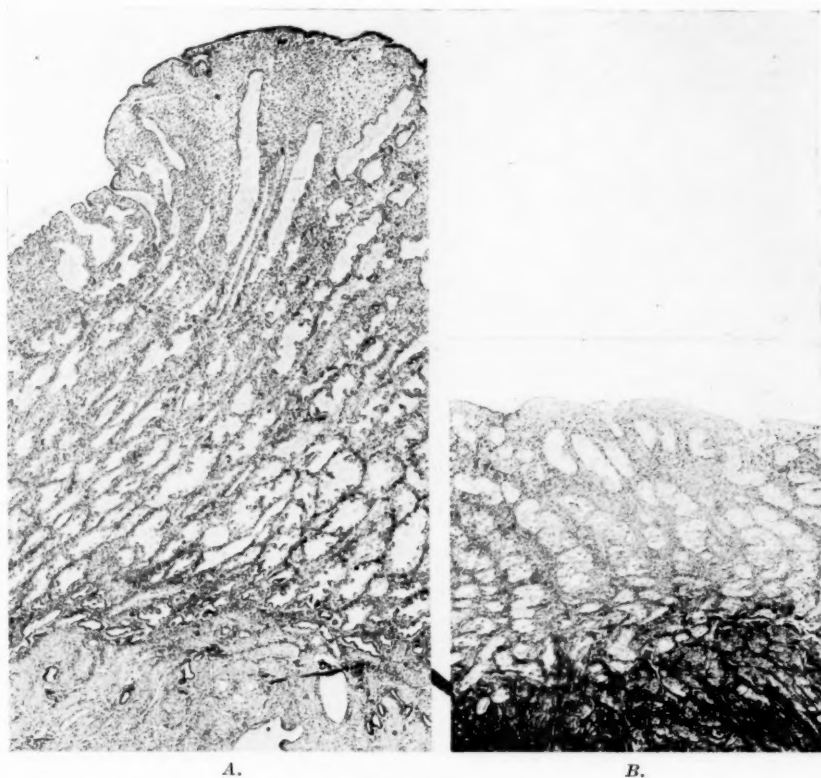


Fig. 1.—Photographs  $\times 20$  of sections illustrating involution of uterine mucous membrane at onset of menstruation. Black line between figures indicates boundary between mucous membrane and muscle. (Cf. Schroeder, 1928, Figs. 67 and 68.) No retouching in this or in any of photomicrographs.

(A) Case 1. Twenty-eighth day of cycle, menstruation is imminent. The mucous membrane was from 3.7 to 4.9 mm. thick in 95 per cent alcohol (therefore more shrinkage than in B).

(B) Case 6. (First day.) From area where no tissue has as yet been lost. The mucous membrane from 1.5 to 2.2 mm. thick in neutral formol.

have made a series of measurements to determine the extent of involution and its place in the sequence of events.

Our original survey of the blocks of uterine tissue in alcohol made it clear that on the first day of the flow in regions where the surface epithelium was still intact, there had been a striking reduction in the thickness of the mucous membrane as compared with gravid stages.



Such measurements can readily be made for the epithelium may stand out very clearly under these conditions, as may be judged from O'Leary and Culbertson (1928, Fig. 15, which presents a photograph from our Case 2). Table I is based on measurements of such material. Only the thickest area of any given menstruating specimen is considered, where tissue loss could be excluded.

TABLE I. THICKNESS OF PROGRAVID AND MENSTRUATING MUCOUS MEMBRANES MEASURED ON BLOCKS OF TISSUE IN ALCOHOL

	PSEUDOPREGNANCY (19 CASES)	MENSTRUATION (8 CASES FROM FIRST AND SEC- OND DAYS)
Maximum thickness noted	7.3 mm.	3.2 mm.
Minimum thickness noted	1.9 mm.	1.2 mm. (The maximum in one case)
Average maximum measure- ments	4.24 mm.	2.29 mm. (46 per cent loss)
Average minimum measure- ments	3.34 mm.	Not included as tissue loss may be involved
General average	3.80 mm.	

From this it appears that the average *maximum* thickness at the outset of menstruation, in regions where no tissue has been lost, is about 68 per cent of the average *minimum* of prograivid stages; it is 60 per cent of the general average and but 54 per cent of the average maximum for pseudopregnancy. The striking changes in the appearance of the mucous membrane may be seen by comparing *A* and *B* of Fig. 1. Such a reduction can be interpreted only as an involution. Its outstanding features are: (1) A more or less complete collapse of the glands due to the discharge of secretion (cf. Fig. 1) and a reduction in the size of the cells (cf. Figs. 9 to 12). (2) A loss of edema fluid. This, with the infiltration, makes the stroma appear much denser than in prograivid stages. Both these conditions are as characteristic of menstruation as the vascular phenomena. (3) A reduction in the blood volume of the mucous membrane where the capillaries are collapsed. To what extent the actual loss of blood is involved in the early phases of involution of which we are speaking, must remain in doubt. The specimen illustrated in Fig. 2 has areas where involution appears to have preceded bleeding from the surface. Loss of blood was, of course, regarded as the chief factor in involution so long as hyperemia was believed to be the chief cause of "premenstrual tumefaction" and the mucous membrane was simply a "blood sponge," filling and being squeezed out again.

How is this reduction which precedes desquamation brought about? There is no intrinsic mechanism for the discharge of the glands. The hyperemia in our material is not great enough to explain it. I would suggest as a working hypothesis that the relaxation of the myometrium which characterizes menstruation (Lahm, 1926) involves a

stretching of the mucous membrane so that its thickness is reduced and the secretion and edema fluid are pressed out. The dilatation of the previously virtual uterine lumen is further increased by the addi-

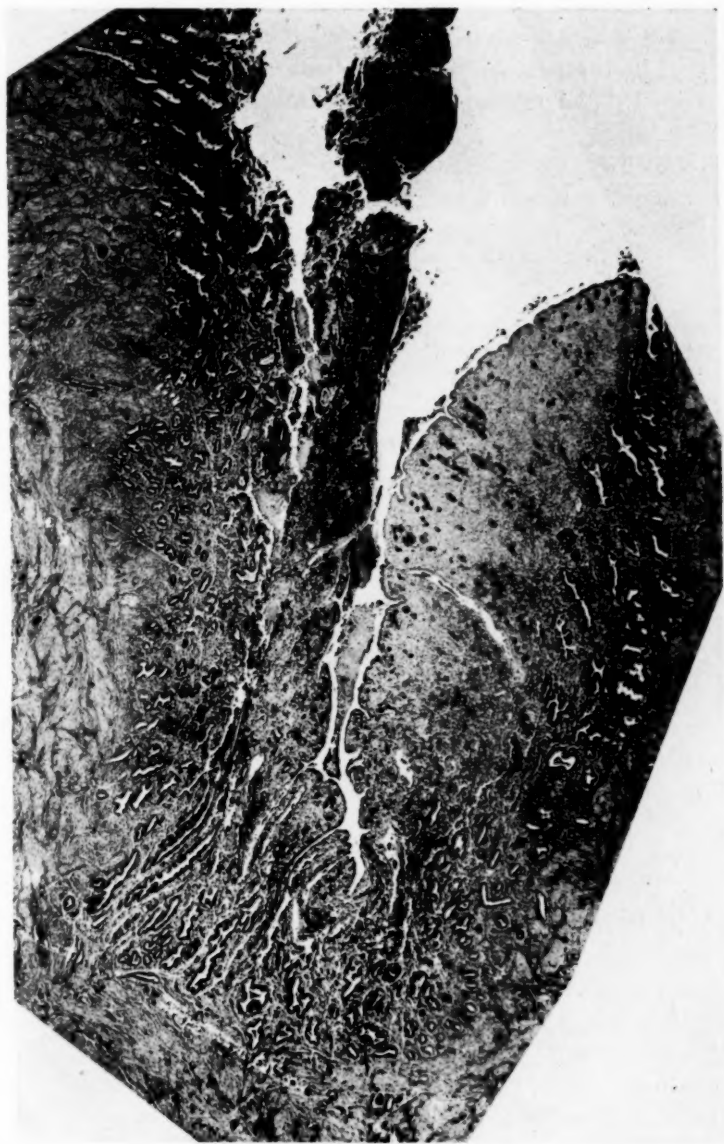


Fig. 2.—Photograph  $\times 26$  of section across body of uterus removed on first day of flow. Case 2. Begins with menstrual congestion at right and precedes to extravasation and desquamation in passing to upper left-hand side of figure. Blood in vessels and free in tissues appears black.

tion of extravasated blood and then there is further stretching of the mucous membrane. This would explain another condition that has been repeatedly described in later menstrual and early repair stages,

viz., the occurrence of glands extending almost parallel to the surface. The reduction in the size of the gland cells and later of the stroma cells also plays a part in the involution. Since this amounts to almost 50 per cent at the very outset of menstruation, it is necessary to have a landmark that can be followed continuously if we are to determine the extent of tissue loss. We must have characters which will enable us to identify the spongy and basal zones in progravid stages and throughout the period of menstruation. The gland form is useful in this respect for even at the time of reepithelization it is often possible to recognize the larger size and greater irregularity in shape which



Fig. 3.—Photograph  $\times 30$  of section from same case as Fig. 2, showing areas of congestion and extravasation. \* Indicates the union of two dilated superficial venules with a radial collecting vein, in a congested region. ↓ Indicates extravasation throughout capillary bed supplied by one radial arteriole. Extravasation may therefore be localized.

characterizes glands of the spongy zone (Fig. 5). They are, of course, much simpler than in the progravid stage for the involution of the gland cells is progressive, but the series of changes can be followed. The irregular or "sawtooth" form becomes more and more blurred and the diameter of the tubules approaches that of the basal zone. It must be remembered, however, that from early progravid stages on, it is not rare to find typical "spongiosa" glands adjacent to the muscle and at best the boundary between the two zones is vague in ordinary histologic sections after the second day of the flow. The differentiation between the zones is clear in Bielchowsky preparations where the

reticular framework is specifically stained. The only investigator who has considered the changes in the reticulum during the cycle is Sekiba (1923), but he did not describe or figure its appearance during menstruation. Our Bielchowsky preparations show no change in the form of the reticulum in the deeper layers during menstruation. It remains looser in the spongy zone and many of the fibers are more



Fig. 4.—Photomicrograph  $\times 200$  of silver preparation showing reticular framework. Case 14 (fourth day). Edge of spreading sheet of surface epithelium indicated by  $\downarrow$ . Form of glands and of reticulum indicates presence of both spongy and basal zones (cf. Fig. 5).

delicate than in the basal stratum. Fig. 4 is taken from a uterus removed on the fourth day from a patient who usually bled for three or four days (Case 14). The new surface epithelium is beginning to spread from the free ends of some glands; below it both spongy and basal zones can easily be differentiated by the character of glands and especially by the looser superficial reticulum. There can be no doubt

here but that some of the original spongy zone has persisted and would have been reorganized later in the repair stage. The specimen has many regions where the remaining part of the spongy zone appears to be disintegrating. One might perhaps assume that all this loose tissue is moribund, but the cells show no evidences of degeneration; furthermore, epithelium can be found spreading out over other similar re-



Fig. 5.—Photograph  $\times 20$  of section of corpus and fundus from Case 14 (fourth day) showing variability in amount of tissue lost in different regions of same mucous membrane. In depths of fundus (bottom of figure) relatively little tissue has as yet been lost. Arrows  $\leftarrow$  indicate spots where entire spongy layer is gone; elsewhere, both spongy and basal layers can be recognized. At \* a dilated gland, and just below it a gland of the gravid type. Compare thickness of mucous membrane with Fig. 1.

gions (Fig. 8). The subsequent expansion of the connective tissue cells of such areas would account for the sudden appearance later on, of a broad regenerative zone of Sekiba. In contrast to these findings of a persisting stratum spongiosum, one can find minute spots where nothing is left but the stratum basale. Two such are indicated by



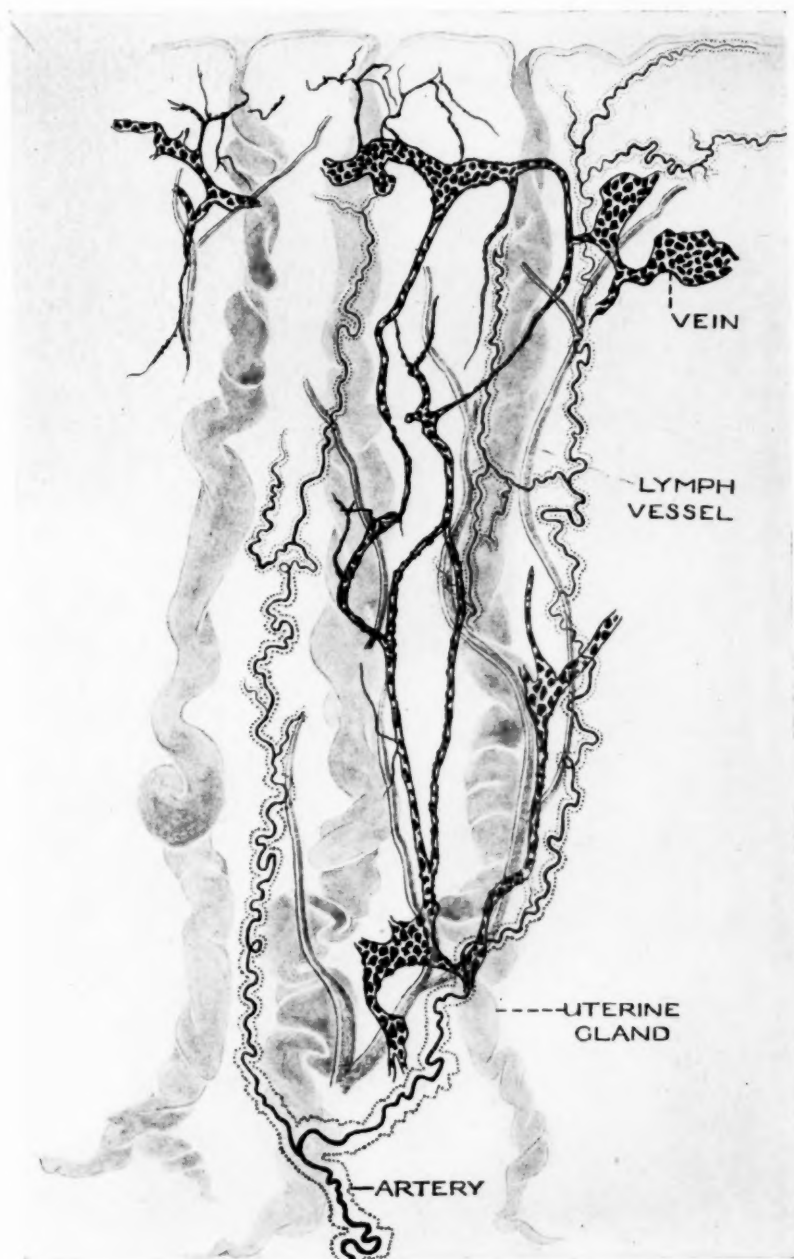


Fig. 6.—Projection reconstruction of glands and vessels from mucous membrane removed twenty-three days after beginning of last period. (Pseudopregnancy.) Note subepithelial arteriole, muscle of which was differentially stained. Lymph vessels followed through series and their independence of the veins demonstrated. (X38)

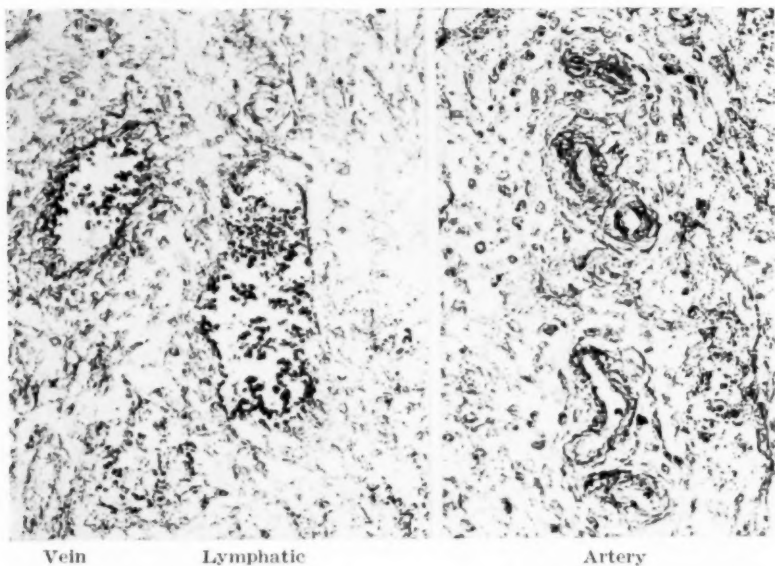


Fig. 7.—Photomicrographs  $\times 200$  from one section of series used in making reconstruction shown in Fig. 6. Note that vein has heavier reticular wall than lymphatic. Both contain only coagulated serum in this section.

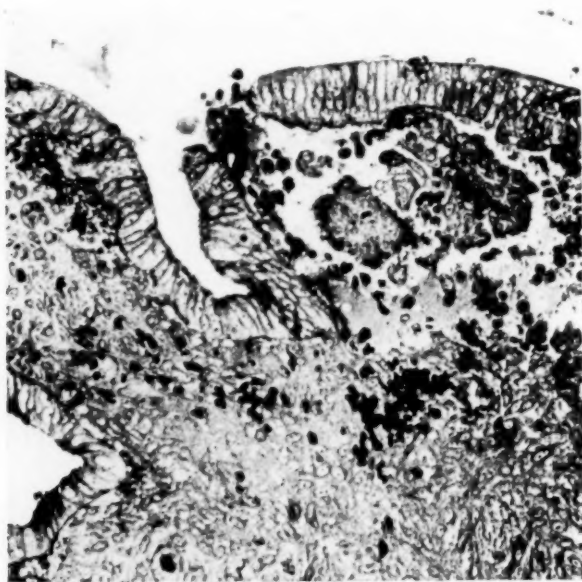


Fig. 8.—Photomicrograph  $\times 250$  from section of corpus uteri (Case 15, fifth day). New surface epithelium has spread over an apparently disintegrating area. Red blood corpuscles appear black.

arrows in Fig. 5. To judge from our material, this is rather the exception than the rule. If, however, we recognize even the sporadic loss of the entire spongy zone, we must admit the probability of all degrees of spongiosa loss from minimal to total. If now, in addition, we consider the part played by involution, as well as the variability in thickness of the mucous membrane as a whole and of its strata at all stages of the cycle, then we are left with no basis for an estimate

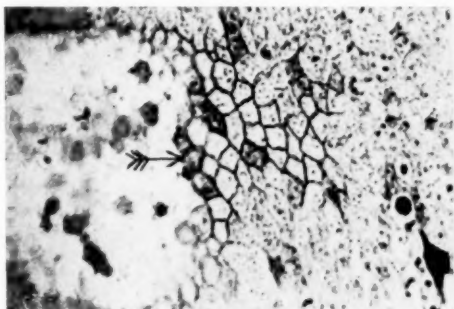


Fig. 9.

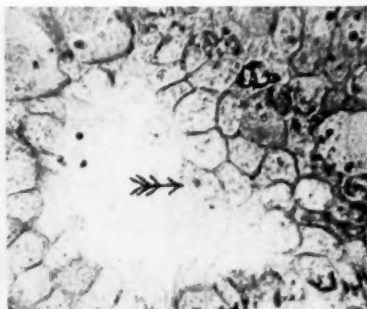


Fig. 10.

Figs. 9-12.—Photomicrographs  $\times 800$ . Fig. 9, Case 8 (second day). A group of cells cut parallel to the surface of epithelium at the level of terminal bars. Compare their size with that of prograavid cells in Fig. 10.

Fig. 10.—From mucous membrane removed on the seventeenth day (pseudopregnancy).  $\downarrow$  Indicates group of cells cut transversely, including terminal bars.

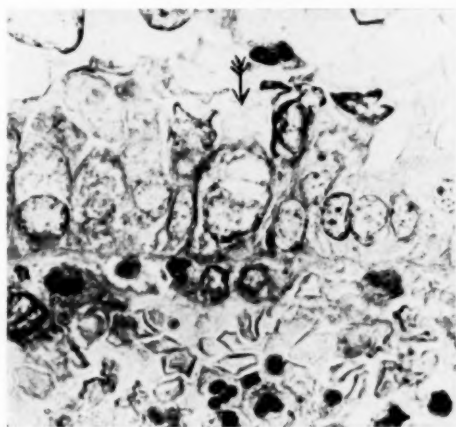


Fig. 11.

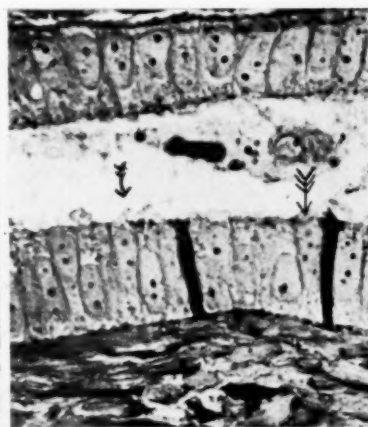


Fig. 12.

Fig. 11.—Group of prograavid cells from Case 2 (first day). Cell indicated by  $\downarrow$  shows advanced stage of hydropic degeneration; cells on either side of it show second (prograavid) type of secretory activity and contain glycogen (deeply stained). Note extravasated blood and degenerating stroma cells below epithelium.

Fig. 12.—From same material as Fig. 9, showing two rod cells. Cells indicated  $\downarrow\downarrow$  illustrate the first or mucoid type of secretory activity which is the only type seen in menstruating uteri after the first day.

of the proportion of stratum spongiosum that is typically lost. Nevertheless, our understanding of the process of menstruation and repair must be influenced by the evidence that the loss is usually not so great as has been recently maintained.

## THE SIGNIFICANCE OF THE VARIABILITY DURING THE FIRST TWO DAYS OF THE FLOW

There are two features which vary strikingly in otherwise comparable mucous membranes: first, the presence or absence of massive extravasation, i.e., the superficial  $\frac{1}{4}$  to  $\frac{1}{2}$  is not always blood-soaked as in the case illustrated in Figs. 2 and 3. Second, there is a significant variation in the evidences of secretory activity in the gland cells. In Case 1 (twenty-eighth day) the general appearance of the mucous membrane is pro gravid (Fig. 1-A). However, the gland cells lack the characteristic blebs usually seen in the pro gravid stage and contain little glycogen. The abundant secretion in the gland lumina demonstrates the antecedent activity. The reduction in glandular activity may be interpreted as evidence of the "failure" of the corpus luteum which, in this alcohol fixed material, had highly vacuolated granulosa lutein cells. There are various other evidences of impending menstruation in this specimen, yet there are only a few small hemorrhagic spots, probably due to trauma (we are dealing here with a defundation). In the light of Case 2, we may say that this is an instance in which the stimulus to secretion ceased before the bleeding into the lumen began. Case 2 (Fig. 2) was removed less than eight hours after the onset of bleeding and likewise has little evidence of secretory activity although in some areas there has been, as yet, no extravasation. The same is true of Cases 3 and 7 which, like Case 2, have abundant evidence of a preceding pseudopregnancy. Contrariwise, the other three cases from the first day (Cases 4, 5, 6) have many gland cells of the pro gravid type and contain more glycogen than Cases 2, 3, and 7. In Case 4, two mitoses in superficial stroma cells were also found. In other words, there is sometimes evidence of corpus luteum activity after menstruation has begun. The second day cases present similar but less extreme differences. The obvious explanation of all this is that bleeding is the most stable of these recurrent phenomena, that the stimulus to secretory activity from the ovary ceases sooner in some cases than in others with reference to the onset of bleeding, and that the vascular changes leading to extravasation are not controlled by the follicular apparatus. Conversely there are instances of clinically typical menstruation in the absence of a corpus luteum (p. 627). That the "failure" of the latter "causes" menstruation is by no means established. To be sure the surgical removal of the corpus luteum in women is usually followed by uterine bleeding (see Watrin, 1924), but we must insist that all extravasation of blood in the mucous membrane is not menstruation. Thus there is good evidence in primates of a normal intermenstrual hemorrhage (for this literature, see Schroeder, 1928, Simpson and Evans, 1928, and Hartman, 1929b) and of an implantation hemorrhage, the "placental sign" of Long and

Evans (1920), which Hartman (1929a) has demonstrated in the macaque. Furthermore, a flow resembling menstruation may follow a series of folliculine administrations in women (Brouha and Simmonnet, 1926) and this even in spayed monkeys (Allen, 1928), although in the latter case, the full pro gravid development of the uterus had not been previously attained. As yet we know practically nothing of the physiologic or histologic differences between these types of bleeding. On the other hand, it will be recalled that Keller and Schickel  (1911) reported "premenstrual" mucous membranes removed immediately after menstruation and that Joachimovitz (1928) had similar cases. It is possible then to find in addition to the ideal cases: (1) Cases where bleeding occurred at the expected time although no corpus luteum was formed; (2) cases in which the corpus luteum had begun to "fail" before the onset of bleeding; (3) cases in which the activity of the corpus luteum persisted after bleeding had begun.\*

All these types are associated with variations in the appearance of the mucous membrane. To dismiss them as "abnormal" or "atypical" would be a convenience no doubt for pedagogic presentation, but progress toward our only goal, the truth, calls for the following of every clue. These "irregularities" all point toward the relative independence from the ovary of the vascular control of the uterus and I am convinced that our understanding of the physiology of menstruation will be furthered by working on this hypothesis. Obviously, the first step must be a detailed study of the cyclic changes in the vascular system of the uterus.

#### VARIABILITY IN DIFFERENT REGIONS OF THE SAME UTERUS

At all stages of the cycle, it is possible to find regional variations in the degree of development of the mucous membrane of the corpus uteri, but I have found nothing corresponding to the placental sites described by Heape (1894) and van Herwerden (1906) in monkeys. Joachimovitz (1928) mentions variability and states that the median regions of the dorsal and ventral walls undergo the most marked pro gravid development, but this simply means that it is less at the lateral angles and in the depths of the fundus. In all our menstruating specimens the process has gone farther in some regions of the corpus uteri than in others, and one may meet with such extreme differences as are shown in Fig. 2 (cf. Sekiba, 1923, and Meyer-Ru gg, 1926, for similar cases). Even on the second day one may find some areas where the surface epithelium is still intact. In one fourth day case

\*Since the above was written, I have killed a macaque on the third day of a flow which began twenty-five days after the previous one, and found a mucous membrane which was 2-3 mm. in thickness, had suffered but little loss of tissue and had new epithelium over much of the surface. The corpus luteum appeared "in full bloom" and contained little osmic reducing fat (osmication after fixation in formol Zenker). Such conditions may, in the human species, account for cases of relatively slight loss during a flow as well as for instances of pro gravid glands and abundant glycogen postmenstrually.



there are all stages from superficial degeneration (depths of fundus, Fig. 5) to almost complete destruction (Fig. 5↓↓) and on to reepithelization (Fig. 4). Case 15 (fifth day) presents similar variability, and various stages of repair are to be seen. We are dealing perhaps with differences in response of different vascular areas as is suggested by the observations of Markee (1929). He obtained convincing evidence that rhythmic vascular changes in isolated bits of uterine mucous membrane are not controlled by the nervous system but by a hormone and found that two pieces transplanted to the same eye usually have different rhythms. It may be then, that there is a degree of physiologic isolation of certain regions in the intact uterus so that they respond differently to a given stimulus (cf. Fig. 3).

#### SUMMARY

*Tissue Loss Following Pseudopregnancy.*—The premenstrual invasion by leucocytes is followed by a reduction of nearly 50 per cent in the thickness of the mucous membrane (Fig. 1). This precedes extravasation and desquamation. It involves a discharge of the dilated glands and of edema fluid and is ascribed to the relaxation of the myometrium. The dilatation of the previously virtual uterine lumen with fluid contributes progressively to the stretching of its lining. Another factor in involution is the reduction in the size of the gland cells (Figs. 9 to 12).

After extravasation the loss of tissue involves part of the spongy zone. The remainder of the mucous membrane comes to resemble superficially the basal zone of gravid stages. It is essential therefore to follow the boundary between spongy and basal zones throughout the menstrual period. The form of the spiral arteries is of no value for this, and gland form is not wholly adequate. The reticular framework of the basal zone remains denser than that of the spongy zone (Fig. 4), and since it is possible to recognize both zones beneath newly forming surface epithelium, it is concluded that the entire spongy zone is not always lost. All loose tissue on the surface of the menstruating uterus is not necessarily lost (Fig. 8).

*Variability and Its Significance.*—In specimens from the first day, the gland cells show great variability in the degree of involution. The explanation offered is that in some cases the stimulus to secretory activity from the ovary continues longer than in others with reference to the onset of the vascular changes that result in extravasation. That is, corpus luteum activity may cease before or persist after bleeding has begun. In these cases then, as in cases of menstruation without preceding ovulation (p. 626), we have evidence that the control of the vascular apparatus is independent of the cyclic ovarian changes. The cessation of menstruation after complete ovariectomy is explained

as due to the insusceptibility of a mucous membrane which has become anemic or atrophic.

Variability in different regions of the same mucous membrane is a constant feature during menstruation as well as at other stages of the cycle. In the later stages of the flow, it is as real although not so striking as it usually is on the first day (cf. Figs. 2 and 5). The variability involves the time and extent of extravasation and extent of tissue loss. This indicates a certain independence of the various terminal branches of the arterial tree.

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## SOME FUNCTIONAL CRITERIA OF NORMAL PREGNANCY\*†

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SOME ten years ago, the author and his associates began a study of certain phases of the metabolism in normal pregnancy as a basis for later investigations of the toxemias, a method of approach that had already yielded concrete results in another field.<sup>1</sup> While there was a scattered literature, the earlier lack of accurate methods for the analysis of the urine, of the blood, and the determination of other objective data had led to contradictory reports and thus failed to establish authoritative criteria. It was patent at the outset that single measurements on isolated cases would fall far short of the significance attaching to continuous studies both ante- and postpartum on the same individual. The adoption of this procedure added materially to the labor involved and to the difficulties of performance, as the element of sustained cooperation by the patients assumed a dominant rôle. The advantages were more than compensatory, however, and the work has been carried out on this basis.

For the purposes of the entire program of investigation, subjects for study were drawn from two independent and sharply differentiated sources. Group I was recruited primarily from the patients reporting to the prenatal clinic of the Robinson Memorial, supplemented by a few volunteers drawn from private sources. The women of this group were all living in their own homes under no dietary or other special control, their pregnancies taking place under the conditions of their individual habit of life.

Groups II and III, on the other hand, were patients selected from the inmates of two nursing homes for unmarried mothers. Here the conditions were diametrically opposite as the individuals were under constant dietary and hygienic control, in short, living under uniform standard conditions and following a regimen largely foreign to their usual practice. Further, in this group, there was a psychic factor with a number of the cases arising from the conditions of the pregnancy. Normal healthy individuals were selected initially and only those retained who maintained this condition throughout the period of study. The elimination of those who developed apparent abnormality and the defection of the much larger group whose interest waned as the study progressed has limited in a most material way the number of completed cases. Considerably more than 200 patients were at least par-

\*This is Number 8 in a series of papers on the Metabolism in Pregnancy.

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tially studied, to yield the series of 77 that forms the basis of these reports. The actual composition of the group and certain descriptive details can be most compactly presented in tabular form.

TABLE I. COMPOSITION OF SERIES

DATUM		GROUP			TOTAL
		A	B	C	OR AVERAGE
Number of Cases		25	21	31	77
Age	High (yr.)	37	40	28	40
	Low (yr.)	18	13	14	13
	Average (yr.)	28	18	19	22
Parity	High	6	2	2	
	Low	1	1	1	
	Average	2.4	1+	1+	—
Weeks of Study:					
Antepartum	High	34	13	25	34
	Low	11	4	6	4
	Average	21	8	14	15
Postpartum	High	10	10	30	
	Low	1	2	5	
	Average	2	6	14	8

The only point of remark is the large number of young mothers; this depends, naturally, on the source from which so large a part of the group was drawn. In another study, embracing several hundred patients, the average age was twenty-seven. On the basis of comparisons between the younger and older in the present group, the figures here presented may be regarded as truly representative.

Many of the results of this study have already been presented in detail elsewhere in the literature,<sup>2</sup> and reference is made to these papers for methods and similar data. The present communication summarizes them, offering in compact form a pattern of function levels to serve as criteria of normality during pregnancy. That this physiologic episode produces a wide variety of changes in the normal non-pregnant metabolic levels has long been recognized; the purpose here is to give them arithmetical expression so that real departures from the normal levels of pregnancy may be justly evaluated both in direction and amount. Postpartum data are included only as they serve as a control on the antepartum values. With this introduction, the data may be presented without further discussion.

1. *Physical Measurements.*—As many of the final results depend upon, or are correlated with, certain easily obtained biometric magnitudes, these may first be considered. Significant data are collected in tabular form.

These values are for magnitudes that remain substantially constant throughout the course of the pregnancy. They serve primarily to illustrate the representative character of the individual variations, and,

equally, the excellent degree of correlation between the averages of the several series. (Table II.)

TABLE II. PHYSICAL MEASUREMENTS

DATUM	GROUP			AVERAGE
	A	B	C	
Height				
High (cm.)	175.0	172.1	167.4	
Low (cm.)	148.0	147.3	151.8	
Average (cm.)	158.8	160.4	160.2	159.8
Trunk Height				
High (cm.)	88.0	91.3	91.5	
Low (cm.)	79.0	79.5	80.6	
Average (cm.)	84.3	85.1	85.7	85.1
Sitting Height Index, Av.*	0.531	0.531	0.534	0.532

\*Dreyer's<sup>3</sup> Sitting Height Prediction (v. 1.)

The observed weight relations constitute one of the important biometric variables. Certain significant data are given in Table III.

TABLE III. WEIGHT RELATIONS

DATUM	GROUP			AVERAGE
	A	B	C	
Av. Observation, A.P. (wk.)	21	8	14	15
Gain Per Week				
High (kg.)	0.74	1.03	0.90	1.03
Low (kg.)	0.15	0.02	0.15	0.02
Average (kg.)	0.32	0.52	0.59	0.48
Weight, 1 Week A.P.				
High (kg.)	84.8	81.2	87.0	87.0
Low (kg.)	53.4	48.4	49.8	48.4
Average (kg.)	67.0	64.4	66.8	66.3
Weight, P.P.				
High (kg.)	76.0	74.6	74.9	
Low (kg.)	43.1	40.4	43.2	
Average (kg.)	57.8	57.1	57.2	57.4
Average Interval (wk.)	2.0	3.5	5.0	3.5
Total Loss in Weight (kg.)	9.2	7.3	9.6	8.9
Weight of Child				
High (kg.)	4.32	4.09	4.04	4.32
Low (kg.)	2.41	2.00	2.38	2.00
Average (kg.)	3.31	3.20	3.28	3.27
Net Loss in Weight (kg.)	5.9	4.1	6.3	5.6
Weight Deviation, P.P. Average	+5%	+1%	-1%	-*

\*Unequal observation periods.

The weight one week antepartum has been selected for presentation rather than the extrapolated value for the day of delivery. The general consensus of opinion concedes a slight loss in weight during the few days before delivery, although there is a lack of uniformity in the



expression of the amount and duration of the decrement. The present figures avoid a controversy not relevant to the present thesis.

The well recognized increase in weight in excess of that conditioned by the growth of the uterus and its contents finds arithmetical expression here as does the restoration to substantially normal weight during the postpartum period. Only the sitting height ("trunk length") prediction is used as the chest values are independable, as will be shown later.

The extremes of the growth coefficients, 0.3 kg. and 0.6 kg., may be regarded as reasonably representative, both for the group bearing the cares of a household during pregnancy, and for that living a more protected life under institutional care.

As these data ultimately are to serve as criteria for comparison with toxemic cases, an appreciable number of whom are bedridden and cannot be weighed, they may be utilized to develop methods for calculation of body weight. Some years ago I derived a formula for the calculation of body weight from the girth of the hips at the point of maximum circumference,<sup>4</sup> which took the following form:

$$\text{Female body weight (in grams)} = \frac{1.387 \times 0.429}{\sqrt{\text{Hip girth (in cm.)}}}$$

This formula was based upon measurements in an erect posture. The present study demonstrates that the hip girth standing averages 0.7 cm. greater than when measured in a recumbent attitude. A correction of +0.7 should therefore be added to the latter measurement. Correlating the observed weights with those calculated by the above formula, it can be shown that 5 per cent must be added to the usual prediction to bring over 90 per cent of the calculated values to within  $\pm 10$  per cent; the average deviation is 4.2 per cent, of those actually measured. As this maximum variation permits of the prediction of the basal rate by either the Harris-Benedict<sup>5</sup> or Aub-DuBois<sup>6</sup> equations to within  $\pm 5$  per cent, it may be regarded as giving a reasonably satisfactory approximation.

Another line of approach comes in the use of the two prediction formulas of Dreyer (*l. c.*) based respectively on sitting height and chest girth. Both were developed to define normal criteria for comparison with observed values, thus giving an arithmetical expression to degrees of over- and under-weight; they naturally were derived from individuals of normal body configuration. As the sitting height remains practically unchanged during pregnancy, the deviations from prediction produced by the weight increment show a progressive upward trend. The chest girth, on the other hand, increases with increment of adipose, and, as these experiences have demonstrated, at a more rapid rate than does the weight. Further, the individual departs more and more from normal habitus, and thus a negative deviation is

produced. To illustrate, from the data, a pregnant woman weighing 63.3 kg. is +26 per cent above prediction from her sitting height of 82 cm. and -22 per cent below from her chest girth of 82 cm. The algebraic mean of these two observations is +2 per cent, an entirely satisfactory calculation. The algebraic mean of these two predictions, as with the modified hip formula, shows over 90 per cent which will give values within the permissible limits of  $\pm 10$  per cent. This study has shown, further, that the chest measure in a recumbent posture is 0.8 cm. greater than with the erect subject from which Dreyer's values are derived. The correction then is -0.8 cm. There remains but one other point to be considered. In the paper already cited<sup>4</sup> the author has shown that the sitting height in the recumbent female can be secured by adding 1.1 cm. to the length from perineum to the vertex, as measured in a recumbent position with special calipers.

2. *Urine Examination.*—Only twenty-four-hour collections were examined. These were kept over toluene at low temperatures during collection and analyzed within a few hours (usually less than three) after completion. The significant results are reported in Table IV.

TABLE IV. URANALYSIS

DATUM	PARTUM	
	ANTE-	POST-
Volume (c.c.)	1680	1260
Specific gravity	1.0170	1.0187
Albumin (+)	26.0%	22.0%
Sugar (+)	35.0%	42.0%
Indican (increased)	12.0%	20.0%
"Urobilinogen" (+)	1.2%	0
Total acid (c.c. N/10 acid)	580.0	570.0
NaCl (gm.)	10.23	8.66
P <sub>2</sub> O <sub>5</sub> (gm.)	1.74	2.03
Total nitrogen (gm.)	8.03	8.04
Urea nitrogen (%)	79.6%	80.8%
Uric acid nitrogen (%)	2.8%	1.9%
Creatinin nitrogen (%)	4.7%	4.2%
Ammonia nitrogen (%)	5.0%	5.1%
Residual nitrogen (%)	7.9%	8.0%
Casts (+)	9.0%	3.0%
Leucocytes (increased)	0.6%	1.0%

Although all the data were analyzed initially from the chronologic standpoint, only averages are reported here as the weekly and monthly averages failed to disclose any variations suggestive of significant trends.

The increased urine volume during pregnancy is well defined. It should not be forgotten, however, that another and special channel of water elimination is developed in the postpartum period, and that the fluid output from these two sources definitely exceeds that from the kidneys antepartum. The specific gravity shows a slight upward tendency after delivery, conditioning a partial compensation for the smaller volume. General elimination is ample throughout. Albumin as recorded

implies only very slight traces at the borderline of detection by both the heat and acetic acid, and the cold nitric acid contact tests. There is an almost equal incidence postpartum. Sugar (glucose) was demonstrated in over one-third of the urines examined antepartum, and lactose was present in two-fifths of those of the second period. The first value is materially higher than the usual record. The whole question has already been discussed at length elsewhere<sup>2-6</sup>; intermittent glycosuria is probably a feature of the majority of pregnancies and comes more frequently in record where consecutive studies are made on the individual. In only 18 per cent of the patients in this series did it recur with any degree of frequency and many of these demonstrated repeated aglycosuric intervals. Prior to the last week antepartum, when it is well known that lactose begins to appear, the sugar was proved to be glucose. The patients were not diabetic. Discussion of this question can find no place in the present report; the facts are recorded. "Increased" indican appeared in an appreciable number of urines both ante- and postpartum though nearly twice as frequently in the latter period. The significance is not great and is chiefly an index of the care given to the bowels. "Urobilinogen" is reported as it has been demonstrated by me<sup>7</sup> that in the urine of pituitary cases there is frequently found a substance that responds positively to the Ehrlich reagent.<sup>8</sup> With the present-day tendency to regard pituitary activity as a dominant factor in the regulation of pregnancy, this figure is of interest. The positive cases recorded showed no more than traces, and these only in urines of the last ten days antepartum. The frequency of occurrence in established pituitary cases ranges from 21 per cent in bilobar failure to 71 per cent in hyperactivity of both lobes.<sup>9</sup> The figures from the pregnant urines are not impressive as suggesting any marked overactivity of the hypophysis.

The acid elimination, calculated from the titratable acidity plus the acid equivalent of the ammonia excretion, is practically constant throughout and within the conventional normal range. The chloride elimination (arbitrarily reported as NaCl as a rough measure of fixed alkali output) antepartum is normal and falls off in the second period. Some chloride, however, is eliminated in the milk though not enough to account for the difference. The total nitrogen fortuitously shows the same level in both periods, both being above a maintenance level. That protein storage occurs antepartum is well known, and, in the period following delivery, the breast milk accounts for a nitrogen elimination of significant proportions. Urea nitrogen shows the recognized depression antepartum, which, however, is also observed in the second period as well. Uric acid is absolutely high and falls after confinement. The ammonia in both periods is relatively high though yet within the normal range. There is a slight falling off of the creatinin output in the postpartum interval for which the milk content<sup>10</sup> fails to

account. The residual nitrogen values exhibit an upward trend but are within the conventional limits of normal variation. This fraction even more than the ammonia seems to be responsible for the lower urea values, an observation not wholly in accord with the usual report. The transformation of urea to ammonia after voiding may be a factor here.

The report of casts rests upon the observation of an occasional hyaline cylinder; in a few instances, an increase of leucocytes was observed in the sediments of urines voided within a few days prior to delivery.

Broadly speaking, the albumin, sugar, volume, and the urea and uric acid nitrogen percentages are the only data departing materially from the accepted norms, and, even here, the degree of the divergence is variable.

3. *Blood Chemistry.*—As the urine derives from the blood, examination of the amounts of the constituents of the latter are of basic interest. It must not be ignored, however, that the urine is an end-result of the summation of a progression of variables and insusceptible of significant change after it enters the bladder. The blood, on the other hand, is under the constant influence of a large number of regulating mechanisms of which elimination by the kidneys is one, and that these operate to maintain a constancy of composition for which the urine has no equivalent mechanism. With urea nitrogen forming from 40 to 50 per cent of the blood nonprotein nitrogen, it constitutes more nearly 85 per cent in the urine partition. An even more striking lack of correlation is shown by the residual fractions, but the composite character of these moieties make this the less significant.

TABLE V. BLOOD CHEMISTRY

	PARTUM	
	ANTE-	POST-
Nonprotein nitrogen (mg.)	25.0	32.0
Urea nitrogen (mg.)	12.0	16.0
Urea nitrogen (% of NPN)	48%	50%
Uric acid	3.3	3.7
Creatinin	1.5	1.5
Residual nitrogen	11.3	14.2
Sugar	83.0	94.0
Cholesterol	177.0	157.0

Of the large number of known constituents of the blood for which exist reliable quantitative methods of estimation, but a few have been studied. This has been conditioned, as have the other compromises in this study, by the basic necessity of maintaining the continuous cooperation of the individual patient. Repeated venipuncture alone has depleted materially the tale of those starting as subjects of this study, and had a fear of exsanguination arisen in the minds of the faithful, the number of completed cases would have been still further dimin-

ished. It is unnecessary to dwell on this topic; those who have attempted continuous studies will appreciate the cogency of the reasons.

The data secured are given in Table V. Again only averages are presented as in the main the detailed analysis failed to uncover suggestive trends.

The lowered value for nonprotein nitrogen so frequently recorded by others is again remarked in this series. A prompt return to more normal levels characterizes the postpartum observations.

The urea figures show the same general relationship, but the lower antepartum values are yet a larger part of the total nonprotein nitrogen than is the report from certain other sources.<sup>11</sup> No patent explanation of the contradiction is forthcoming; the matter has already been discussed elsewhere in detail.<sup>2-d, 11</sup>

Most recently, through the courtesy of my associate, Dr. R. S. Hunt, a series of independent observations has been made, and the average value of these (nonprotein nitrogen 27 mg.; urea nitrogen 12 mg. or 44.4 per cent) compares satisfactorily with the values here recorded.

Uric acid was determined throughout by the Folin-Wu<sup>12</sup> procedure in order that the values should be mutually comparable. The two averages are normal, that antepartum being somewhat the lower. This is possibly interesting in connection with the fact earlier recorded, that the urine uric acid during the first period was 50 per cent greater than during the second where higher blood uric acid levels prevailed. The hydremia, well established as a feature of normal pregnancy, should account, in part at least, for all of the lower antepartum figures. The percentile differences of the several increments preclude the acceptance of this as the sole agent. Creatinin is normal throughout, a fact to be predicted from the relative invariability of this component. The antepartum residual nitrogen is frankly low, the usually accepted normal being  $15 \pm 2$  mg. Parenthetically, this observation bears directly on the question of the blood urea percentage. In the present series, the data do not warrant the interpretation that the residual fraction is increased at the expense of the urea moiety. It increases to within the normal range after delivery. The low blood sugars antepartum, also by the earlier Folin-Wu<sup>13</sup> method, are still within the normal range. They are significant only in contrast to the higher value established after the termination of the pregnancy.

Blood cholesterol, as has been remarked by others, shows a real increase above normal levels in the antepartum period, especially if allowance be made for the hydremia, and recedes to the normal after delivery. This is one blood constituent that may show some slight time influence. In this series, about half of the cases showed a progressive upward trend, the remainder being divided equally between those exhibiting no difference and those showing a definite decline.



No attempt was made to secure sodium chloride values as this substance seems to show a relative invariability exceeded by but few of the blood components. It is to be regretted that studies could not be made on the other lipoids, the mineral constituents, and the acetone bodies. Certain of these will be made the subject of future investigations. Plass<sup>14</sup> and his associates, among others, have demonstrated the variations in the several protein fractions in a most comprehensive manner.

4. *Blood Morphology*.—No definite trends were disclosed by chronologic analysis, and consequently the data are presented as averages for the ante- and postpartum periods. The significant figures are collected in tabular form.

TABLE VI. BLOOD MORPHOLOGY

DATUM	PARTUM	
	ANTE-	POST-
Hemoglobin	66%	73%
Erythrocytes	4,140,000	4,380,000
Color Index	0.80	0.83
Leucocytes	9,680	7,910
Polymorphonuclear Neutrophiles	69%	59%
Lymphocytes	25%	34%
Endothelial Leucocytes	5%	5%
Eosinophiles	1%	2%

But few points require comment. The erythrocyte count shows a decline antepartum which is of the order of the blood dilution and may derive from this well established change. Hemoglobin, on the other hand, shows a definitely greater decrement, indicating an absolute lowering of the blood content of this essential constituent. The picture is one of a moderate secondary anemia with lowered color index.

The leucocytes are somewhat increased antepartum, the upward tendency gaining greater significance from the opposing influence of the hydremia. The differential formula is normal, the blood showing a leucoid (adult) type. After delivery, the leucocyte count falls to more average levels, chiefly at the expense of the neutrophilic elements. This conditions a relative increase in the lymphocyte group, thus determining a more lymphoid type of blood.

5. *Respiratory Metabolism*.—Deviations from the predicted normal basal rate have a very real diagnostic significance as the numerous publications in recent years bear witness. Further, it has been reported by a number of investigators that the basal rate increases during pregnancy by an amount well in excess of that conditioned by the weight increase. The number of individuals reported, however, with whom protracted continuous studies have been made, is small. In this, as in so many other fields of biology, a multiplication of coordi-

nated measurements is necessary to absorb individual differences and to define the normal zone with any real certainty. In the present study, three wholly independent series were carried out, computed separately, and the three curves of change thus defined, compared. The slopes were identical in the two extreme series, and practically so in the third which fell midway between them. The values with Series "A," from women who came for the test from their homes to the hospital, averaged 6 per cent higher than in Series "C," where the machine was carried to the patient in the bed in which she had slept, and who frequently was awakened from sleep to prepare for the measurement. The subjects in Series "B," whose curve defines the mean position, were moved from one to another room in the same building. It is felt that these differences in procedure may well explain the numerical differences in the rate. Incidentally, these several procedures define the extremes of practice. For the sake of convenience, the average values have been computed and reduced to tabular form. It will be understood that the two sets of limiting values are respectively 3 per cent above and below those given in Table VII. For possible convenience to the user, the figures postpartum are included. The comment on the first part of the curve is equally applicable to the second, with the exception that but one measurement was made on the patients in Series "A," and that immediately prior to their discharge from the hospital where they had been confined. The sharp drop in the rate showing a maximum depression between the third and fifth weeks postpartum with speedy restoration to a substantially normal level seems to be characteristic. All the deviations as recorded are the means of these indicated by the Harris-Benedict<sup>5</sup> and Aub-DuBois<sup>6</sup> predictions.

TABLE VII. PROGRESSIVE CHANGE IN BASAL METABOLIC RATE

Weeks	24	21	18	15	12	9	6	3	0
A.P.	-8%	-6%	-5%	-3%	-1%	±0%	+2%	+3%	+5%
Deviation									
P.P.	-	-	-4%	-4%	-4%	-5%	-12%	-12%	-

TABLE VIII. PHYSICAL DATA FROM BASAL RATE

DATUM	PARTUM	
	ANTE-	POST-
Pulse	78	67
Respiration	17	17
Temperature	98.1°	97.8°
Blood Pressure:		
Systolic	108	112
Diastolic	67	70

The curve is not carried beyond the beginning of the twenty-fourth week antepartum as the number of observations is too few to give confidence in the trend of the curve. It is seemingly rectilinear up to the

thirtieth week, and such an assumption, in the study of early cases, could not lead to gross error. The extrapolated magnitudes, further, are of the order of those recorded in a group of patients referred for diagnostic study (amenorrhea) and subsequently proved to be pregnant.

A basal rate report is wholly incomplete and may be seriously misleading which does not include the data on pulse and respiration rates, body temperatures, and blood pressures recorded at the time of the basal measurement. Those resulting from this investigation are collected as averages in Table VIII.

The pulse rates before delivery are somewhat high; they sink to normal in the postpartum interval. The respiration frequencies are unchanged. The temperature is  $0.3^{\circ}$  higher antepartum than that after

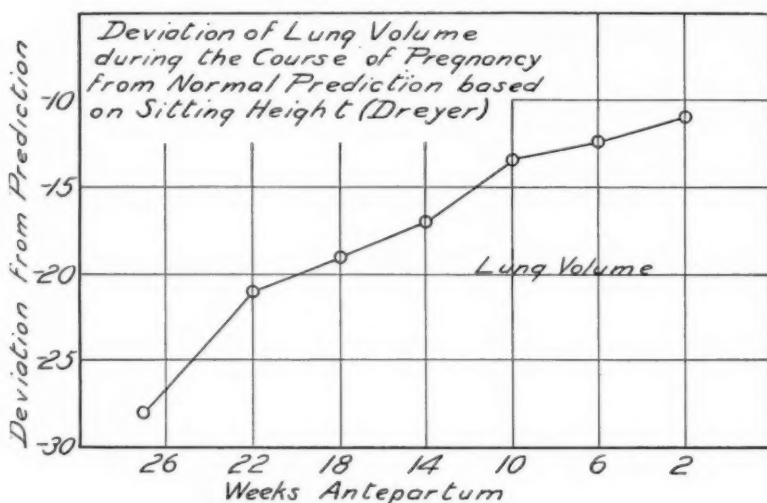


Fig. 1.

confinement. Pregnancy normally produces a lowering of the blood pressure; this exhibits an upward tendency postpartum, but, within the time limits of this study, fails to reach the conventional normal level.

6. *Vital Capacity*.—This datum, usually so designated, but more properly reported as Lung Volume as it represents the maximum amount of air that can be expelled after deep inspiration, is peculiarly susceptible to the degree of the patient's cooperation. That it shows a progressive upward tendency during pregnancy has already been recorded, and that in spite of the fact that the growing uterus would seem to exercise an opposing influence tending to determine a decrement. The present figures are wholly confirmatory. As the absolute value depends upon the size of the individual, relative values have a more general application. Using the Dreyer<sup>3</sup> correlation with sitting

height (those with weight and with chest girth are independable for present purposes), the variations observed may most easily be presented in graphic form.

While the increment is continuous, in this series at least, the coefficient of increase falls off in the last ten weeks. Further, as compared with the far from exacting standard of Dreyer's "B" Class, at no time do the patients reach the level of prediction. The influence on this test of the degree of cooperation is undoubtedly one subversive factor. The figures may be regarded as typical for the group here represented.

7. *Alveolar Carbon Dioxide*.—It has been a recognized fact for some time that the tensions of the alveolar carbon dioxide are depressed to levels ordinarily associated with acidosis. The present data offer no exception to this generalization. They can be presented most simply in graphic form.

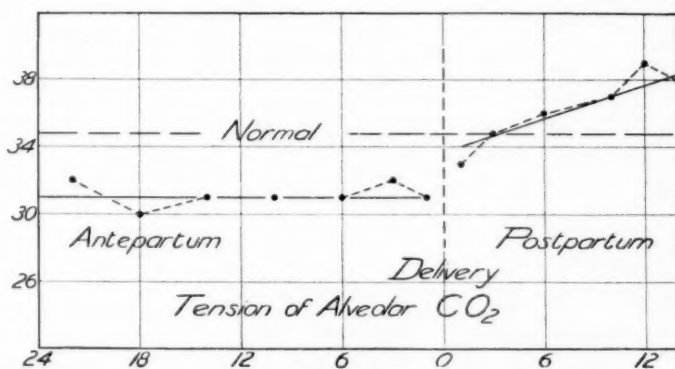


Fig. 2.—Tensions of alveolar carbon dioxide (arterial) in millimeters of mercury both ante- and postpartum.\*

8. *Galactose Tolerance*.—During the past few years, I have published a series of papers on certain phases of the metabolism of galactose.<sup>15</sup> Briefly, it may be stated that during the prepuberal period an oral dose of 20 gm. of this sugar will produce a brief, slight galactosuria, while a 10-gm. test meal yields wholly negative results. With the onset of menstruation, the assimilation limit rises, and in the course of a year or even less attains the adult level of 40 gm., which persists to the menopause, and possibly beyond. Exception to this is found in pregnancy where, following conception, the assimilation limit falls and ultimately, at some time prior to delivery, uniformly reaches the prepuberal level of 20 gm. For a short time (2 weeks or less) after confinement, there is a further decline to 10 gm., probably conditioned by the synthetic activity of the mammary glands, and then the tolerance rises steadily so that usually at the end of six months it is re-

\*Acknowledgment is made to the *American Journal of Physiology* for the use of this plate.

stored to the normal adult level of 40 gm., even though the woman may still be lactating. The results of repeated tests on this series are given in Table IX.

TABLE IX. GALACTOSE TOLERANCE

PERIOD (MONTHS)	TOLERANCE LEVEL		
	20 GM.	30 GM.	40 GM.
3	67%	33%	0
4	67%	33%	0
5	63%	37%	0
6	67%	33%	0
7	62%	38%	0
8	89%	11%	0
9	100%	0	0
Delivery			
1*	100%	0	0
2	73%	27%	0
3	100%	0	0
4	67%	33%	0
5	25%	75%	0
6	0	50%	50%
Over 6	0	0	100%

\*Third and fourth weeks only.

But little comment is necessary. Patently, as early as the third month the majority of the cases show a tolerance depressed to the terminal level. This proportion continues through the greater part of the antepartum period, and only at the very end is the lowest figure (20 gm.) shown uniformly by all. Similarly, after delivery there is a gradual rise, scarcely of significant proportions during the first three months, but increasing steadily thereafter so that in this series, after six months have elapsed, all have returned to the normal adult level, irrespective of the mammary status. The figures of Table IX define criteria for normal performance with such definition as the test allows.

Certain other special observations were made with this series, but they have been, or will be, discussed elsewhere and are not an integral part of the present investigation.

The data given here define representative values for a variety of objective measurements in normal pregnancy. Many are in close agreement with similar data derived from the study of women in a state of sexual rest; other manifest what can only be interpreted as changes incident to the special physiologic status. Combined, they define normal criteria for use in the study of disease conditions which may be engendered or complicated by pregnancy.

The author wishes to express his basic indebtedness to those who have shared in these investigations, his associates, Helen L. Banks, Marion D. Alcott, Endora Mortimer, Dorothy E. Gallivan, Helen Matthews, Mary A. McManus, and William F. Donovan, to the staffs of the Robinson Memorial, the Talitha Cumi Home and Hospital, and the House of Mercy, and to the patients who have so freely sacrificed their comfort and convenience to make this work possible.

It is a pleasure, also, to acknowledge obligation to the generous aid of the American Association for the Advancement of Science which has greatly facilitated the work on respiratory metabolism.



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No attempt has been made to review the somewhat extensive literature in this field. References to the author's work are purely expository. The remaining few citations are for purposes of documentation.

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**Devraigne, Sauphar, and Mayer: Treatment of Puerperal Infection With Intravenous Injections of Aseptic Pus:** Bull. Soc. d'obst. et de Gynéc. **18**: 459, 1929.

The authors have injected aseptic pus intravenously in cases of puerperal sepsis, and maintain there is no danger in this procedure. They have never observed embolism or anaphylaxis. The utilization of aseptic pus for postpartum and post-abortion infections is not new but the intravenous route is a new departure. The latter method is more rapid, more energetic, and more efficacious. The procedure may be employed prophylactically with great benefit. The action of aseptic pus is purely transitory and all it does is to add deficient ferments. Hence the treatment must be continued for a long time with regularity not only until all local and general signs and symptoms have disappeared but even afterward. With this treatment other forms of therapy should be combined. In very severe cases the value of this form of treatment is enhanced by the production of a fixation abscess.

J. P. GREENHILL.

## EFFECTS OF EXPERIMENTAL TORSION OF UTERUS ON THE VESSELS OF PARAMETRIUM AND CONTIGUOUS TISSUES

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**C**LINICALLY it is well known, that patients with a history of infection during the puerperium show marked pelvic varicosities. This can be explained by the end-results of an exudate which nature has healed by the formation of scar tissue. The arteries are shrunk, the venous circulation is interfered with and hence dilatation of veins occurs.

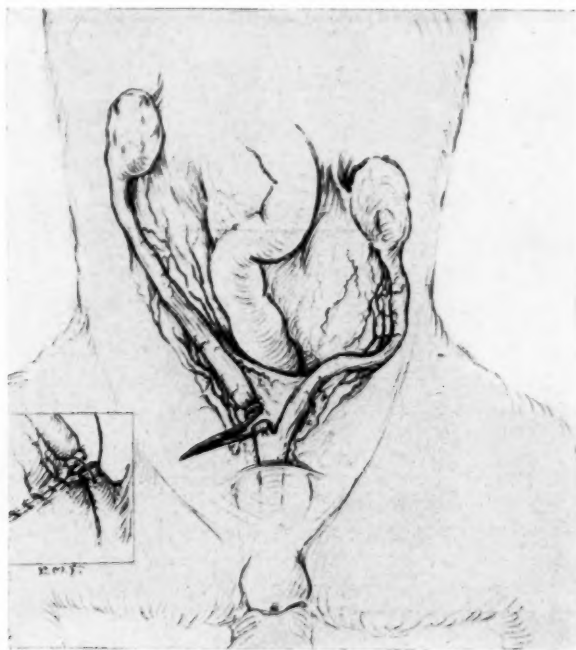


Fig. 1.—Showing removal of section of right uterus and broad ligament in a dog.

Patients with a grossly negative pelvis giving a history of a previous pelvic inflammation complaining of pain in lower abdomen frequently show pelvic varicosities. The second group presenting this picture is comprised of cases with uterine displacements, tumors, lacerations, and pregnancy. The contributing factors in this latter series are merely pressure, torsion or interference with the return (venous) circulation, hence dilatation results. The pelvic vessels become more readily dilated because of the anatomical absence of valves.

With the clinical view in mind, that infection is not the only cause for pelvic varicosities, we have attempted to prove experimentally that displacement or torsion of uterus thereby interfering with the return flow must be considered as factors. For this purpose the following experiments were performed on dogs. Anatomically dogs have a bicornuate uterus fusing in the lower portion.

With the strictest surgical asepsis and antisepsis a section of the right uterus close to the fusion was taken with some of the broad ligament. The edges were approximated with catgut and hemorrhage controlled. The corresponding uterus

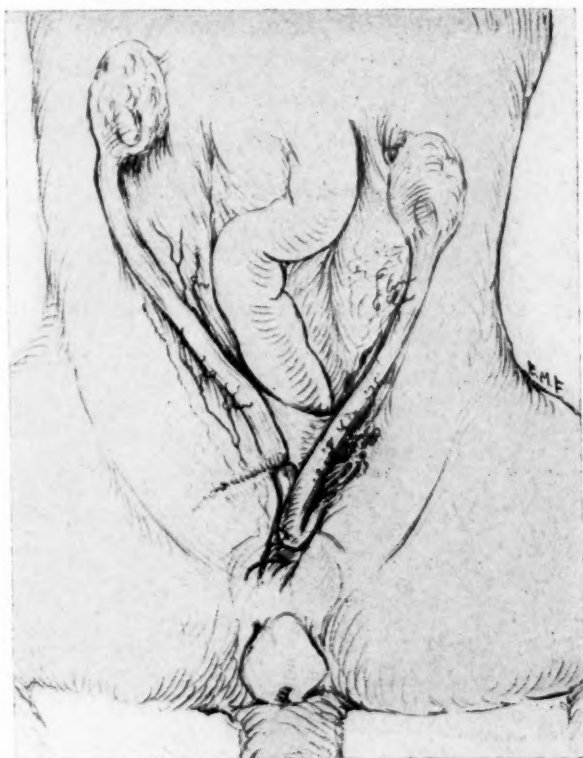


Fig. 2.—Showing left uterus sutured to fused segment and entire structure twisted to left side.

was then bent and sutured to the fused segment and the entire structure was therefore twisted to the left side. About three weeks later another celiotomy was performed and it was grossly observed that the twisted portion was markedly hypertrophied and numerous varicosities were present in the broad ligament. A partial hysterectomy was done and sections were made through the uterus and adjoining broad ligament corresponding to the sectioned right uterus removed on previous operation. The following were the microscopic findings on both sections:

*Section through uterus on right side (untorsioned).* The endometrial surface is smooth consisting of a single layer of columnar epithelium. These cells contain a moderate amount of cytoplasm and a nucleus which is pyknotic. Just beneath the endometrial lining areas of recent hemorrhage are frequently encountered. The

stroma is composed of low connective tissue in which are present a moderate number of oval cells with an occasional small mononuclear lymphocyte. The gland spaces are of the simple tubular variety. They are moderate in number and lined by a single layer of columnar epithelium that is actively secreting. The nutrient vessels in the stroma are congested. The inner circular muscle coat is well defined. The

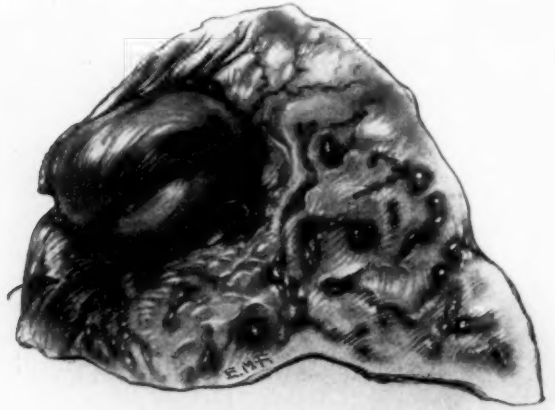


Fig. 3.—Showing segment of torsioned uterus and broad ligament. (Anterior view.)



Fig. 4.—Showing segment of torsioned uterus and broad ligament. (Anterior view.)

muscle cells are spindle shaped, containing an oval vesicular nucleus. The blood vessels just beneath this layer are numerous and congested. The outer longitudinal muscular coat is well defined. The serosa apparently normal.

*Section through the parametrium reveals numerous, large vessels which are congested, suspended in loose connective tissue in which occasional small mononuclear lymphocytes are seen.*

*Section through the torsioned uterus reveals a marked increase in the size of the uterine cavity. The lining epithelium is gyrated, consisting of hypertrophied and hyperplastic columnar epithelium. An occasional tubular gland is encountered. It is lined by columnar epithelium. The endometrial stroma is thinned out, com-*

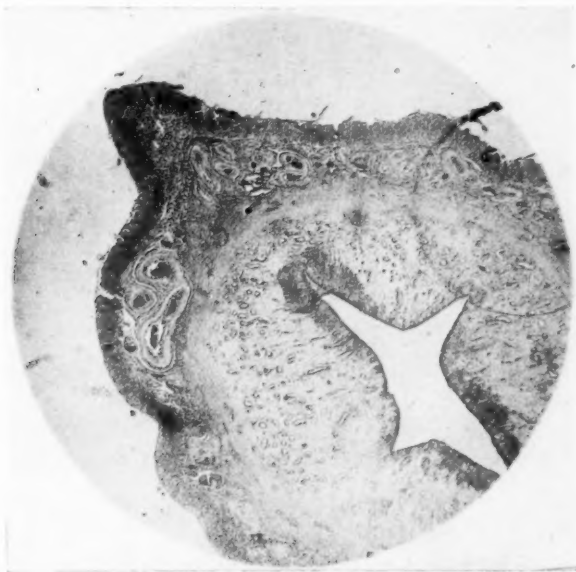


Fig. 5.—Low power section of normal uterus.

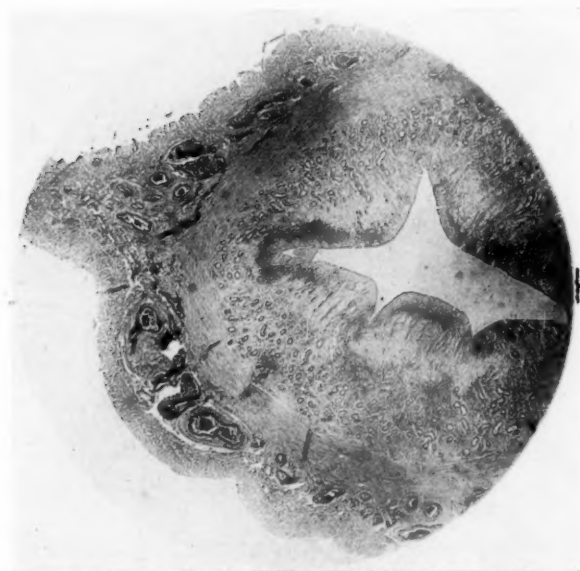


Fig. 6.—Low power section of torsioned uterus.

posed of connective tissue and small spindle cells. The blood vessels here are numerous and markedly engorged with blood. The inner circular mucosa is markedly hypertrophied and hyperplastic. The individual cell is larger and the nucleus takes



a slightly deeper stain. Numerous congested blood sinuses are present within this coat. The blood vessels situated between the inner circular and the outer longitudinal muscle layers are increased in number and size and all are engorged with



Fig. 7.—Section of normal uterus, elastic tissue stain.



Fig. 8.—Section of torsioned uterus, elastic tissue stain.

blood. The outer longitudinal coat too is hypertrophied and hyperplastic. The serosa is slightly edematous.

*Section through the parametrium* reveals a marked increase in the size of the blood vessels and the congestion here too is very marked.

The characteristic findings with the Weigert stain reveal an increased amount of elastic tissue in all the coats of the uterus as well as in the arterioles and arteries. The stain is heavier and the fibers are thicker.



Fig. 9.—Low power section of broad ligament, normal side.



Fig. 10.—Low power section of broad ligament, torsioned side.

#### SUMMARY

*Sections of the torsioned side* revealed a marked hyperplasia and hypertrophy of all the several coats of the uterus, i.e., endometrial,

muscular and serous. There was a marked increase in the number and of the blood vessels. There was also an actual increase in the elastic tissue ratio of the blood vessels while the connective tissue ratio of the entire organ was grossly increased.

#### CONCLUSION

The above experiments show clearly that displacement of uterus causes an increase in size of organ, and in the number and size of blood vessels. The apparent interference of return circulation being the chief factor. Clinically, fibroids, ovarian cysts, pregnancy, uterine displacements, and lacerations, all predispose to pelvic varicosities. Hence interference in the venous flow in the pelvis will cause varicosities in the absence of infection.

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#### Ferrari and Honel: Subtotal Abdominal Hysterectomy and Venous Ligation in Puerperal Infection. Arch. franco-belges de chir. 30: 1, 1927.

In many cases of puerperal infection operative interference is indicated. The authors favor the abdominal route because it permits more accurate palpation of the pelvic veins, better hemostasis, and the time consumed by the operation is shortened. They feel that in the majority of these cases subtotal hysterectomy is a better procedure than removal of the entire uterus. Occasionally where there has been a low implantation of the placenta or where the cervix is frankly infected the latter method may be the procedure of choice.

Subtotal hysterectomy and venous ligation are indicated where there are, despite medical treatment, persistent signs of puerperal infection. However, blood cultures must be negative, the test being repeated at least three times before operation is undertaken. The pathology present may be either multiple small abscesses of the uterine wall or an infected thrombophlebitis of the pelvic veins. The thrombosed veins may be felt as cord-like structures in the base of the broad ligaments. The clinical onset of thrombophlebitis may be following a mild uterine infection which may pass unnoticed or clear up rapidly under medical treatment; again it may occur following more pronounced uterine infection which clears up only with difficulty; or finally it may be associated with a frank uterine infection which persists despite treatment. In the first instance ligation of the veins is sufficient, and hysterectomy is not indicated; in the second it is questionable whether or not hysterectomy should be carried out; while in the third both hysterectomy and venous ligation are indicated.

These authors have operated upon 7 patients. In 2 cases hysterectomy and ligation of the common iliac veins was carried out, in 1 the inferior vena cava ligated, while in 4 cases the inferior vena cava and the utero-ovarian veins were ligated. Of the 7 cases, 5 recovered.

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## TORSION OF UNDISEASED UTERINE ADNEXA IN VIRGINS

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THE purpose of this paper is to consider the twisting of oviducts and ovaries which are otherwise normal without other coexisting pelvic pathology. In order to eliminate all reasonable possibility of inflammation it is deemed advisable not to include those cases in which the condition has occurred beyond the age of sixteen years. It must be realized that coitus introduces the possibility of pelvic infection, and there is no assurance of virginity beyond this age. Perhaps we should have limited our consideration of cases to those who had not reached puberty, because occasionally the state of virginity is terminated soon after. On the maternity services of two Detroit hospitals 94 girls sixteen years of age or under were delivered in one year (1929) and one of the patients was only eleven years old. During this same period of time (one year) the records of the Juvenile Court of Detroit show that of the 1886 girls sixteen years of age or under examined, only 566 or 30 per cent had intact hymens. Schied<sup>1</sup> in 1922 reported having operated upon a fifteen-year-old patient with pyosalpingitis and another, thirteen years old, with chronic active salpingitis. Gonorrheal vulvovaginitis in children and young girls is a common disease. Married women could not be considered, even if there were not the element of pregnancy, because the assurance of normal oviducts in this group is still more remote.

The twisting of previously diseased tubes and ovaries is not an uncommon occurrence. That complicating hydrosalpinx and ovarian tumors occurs most frequently. However, upon eliminating all reasonable possibility of previous pathologic conditions, the number of reported cases is found to be very small. A careful search of the literature reveals only six cases of twisted otherwise normal fallopian tubes. These have been reported by Schwartz,<sup>2</sup> Koster,<sup>3</sup> Hansen,<sup>4</sup> Rogers,<sup>5</sup> Darner,<sup>6</sup> and Gabe,<sup>7</sup> in girls sixteen, sixteen, fourteen, sixteen, thirteen, and fifteen years of age respectively. Two cases of torsion of a normal ovary have been reported by Johansson<sup>8</sup> and Rost,<sup>9</sup> in patients six years and four months old. Ten cases of torsion of both tube and ovary without other pathology could be found reported by the following authors: Wachtel<sup>10</sup> (2 cases), Neugebauer,<sup>11</sup> Smith and Butler,<sup>12</sup> Auvray,<sup>13</sup> Cassidy and Norbury,<sup>14</sup> Munroe<sup>15</sup> (2 cases), Scheid,<sup>16</sup> and Fiolle.<sup>17</sup> The respective ages of these patients were four, sixteen, six, nine, eleven, fourteen, ten, eleven, thirteen, and ten years. Perhaps one of the cases reported by Munroe should not have been admitted because the mass was described as being the size of a lemon or small orange and suggests other pathology. Other articles are worthy of mention.

Anspach<sup>18</sup> collected and reviewed over 80 cases of twisted tubes, both normal and pathologic, mostly in multiparous women, but 13 were classified as virgins. He also quoted Heil as having operated upon a patient with twisted "normal" tube, but there was a dermoid cyst of the ovary. Cohen<sup>19</sup> described a case of twisted tube and ovary in a girl of thirteen years of age but the mass was so large that ovarian tumor was suspected and this was not ruled out by pathologic examination. Schwartz<sup>2</sup> described an additional case in a patient twenty-two years old. Vigholt<sup>20</sup> contributed a case of tubal torsion in a seventeen-year-old girl who was probably a virgin. Norris<sup>21</sup> reported a case of twisted normal ovary in a nineteen-year-old virgin. Reuder's<sup>22</sup> article described three cases of twisted normal tubes in alleged virgins between the ages of twenty and twenty-two. Smith and Butler<sup>12</sup> abstracted the records of 24 previously reported cases of torsion of ovarian tumors in patients between the ages of two and fourteen years and while this is somewhat beside the subject which we are considering, it is interesting because of the age incidence. Haultain<sup>23</sup> reported a case but the age was not given. Bauer<sup>24</sup> described a twisted ovary in a thirty-year-old married woman. Gillies<sup>25</sup> mentioned a case of twisted tube in a single girl twenty-three years old and Jefferson<sup>26</sup> another in a single

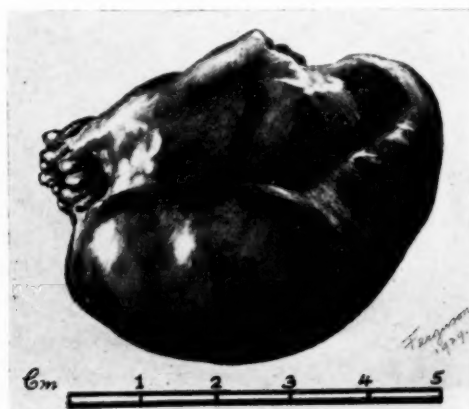


Fig. 1.—Drawing of specimen removed.

woman thirty-two years of age. Koster<sup>3</sup> found in the literature eleven cases of torsion of normal tube in nulliparous women, but some were married and others were beyond the age requirements of this paper. Caraven<sup>27</sup> reviewed the literature on this subject in 1927 and included a case reported by Hussy in 1922 and another seen by Racher and Jeanneney and reported by Auvray in 1926. In these cases the adnexa were presumably normal otherwise.

#### CASE REPORTS

**CASE 1.**—(No. H-2631.) A girl, aged seven, had always enjoyed good health until twenty-four hours before she was admitted to the Clinic complaining of severe left lower abdominal pain. The trouble had begun quite suddenly the previous morning with upper abdominal pain which radiated to the left lower abdomen. She became nauseated and vomited several times during the day and during the night and early next morning the pain localized in the lower left abdomen. The pain was constant and at times quite spasmodic. The bowels had been regular and there had been no urinary symptoms. Physical examination showed a patient in considerable distress, crying at times with pain. The temperature was 98.6° F. and the pulse was 90 per minute. The heart and lungs were normal. The abdomen was not distended and the wall was flaccid. There was extreme tenderness over



the left lower quadrant with some left rectus rigidity on pressure. Laboratory examination was as follows: Hemoglobin 90 per cent, W.B.C. 13,000 with 78 per cent polymorphonuclears and 22 per cent lymphocytes. The uranalysis was negative for albumin and sugar. Laparotomy was performed through a four-inch low right rectus incision. On opening the abdominal cavity bloody fluid was found. Exploration of the appendix showed it to be quite normal with a few peri-appendiceal congenital bands. Exploration for Meckel's diverticulum was negative. Examination of the pelvis revealed a tumor about the size of a hen's egg which consisted of the distal one-third of the left tube and left ovary. The mass was black and strangulated, due to the pedicle being twisted. There were five complete turns. The uterus, right tube, and right ovary were normal. Upon untwisting the pedicle the circulation did not return and removal of the ovary and distal half of the tube was necessary. Appendectomy was performed and the abdomen closed. The patient made an uneventful recovery.

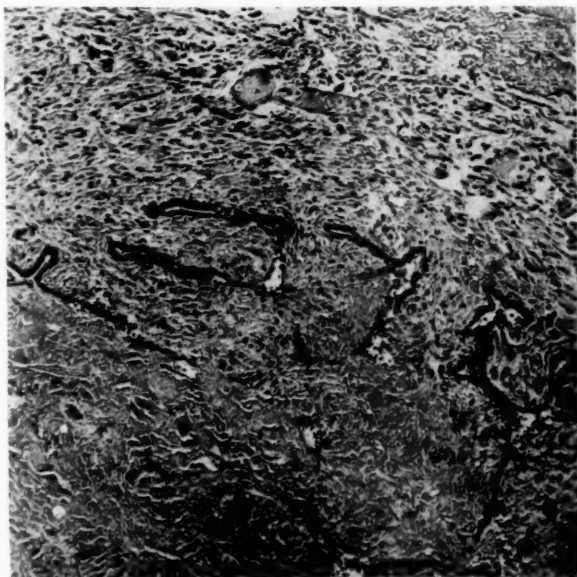


Fig. 2.—Deformity of oviduct tissue due to hemorrhage.

#### PATHOLOGIC REPORT

*Gross Examination.*—The specimen is a kidney-shaped piece of tissue, bluish black in color, uniformly firm in consistency, measuring 6.5 cm. from pole to pole and 4.5 cm. in greatest diameter. The surface is slightly irregular in outline, but smooth and glistening without evidence of rupture. The major portion of the mass is composed of a markedly enlarged ovary to which, in the "hilus" position, lies the distal two-thirds of the fallopian tube measuring 4 cm. in length and 1.4 cm. in diameter. The fimbriae are present but markedly swollen and discolored. The greatest length of the ovary is 6.5 cm. and the greatest diameter 3.1 cm.

*Microscopic Examination.*—In the sections of ovary the picture is that of marked hemorrhagic extravasation which almost completely destroys the normal tissue structure. Occasionally a markedly dilated vessel can be seen. The tunica and a narrow underlying zone of cortex show evidence of pressure atrophy and stretching and constitute the only recognizable ovarian tissue remaining. The hemorrhage has evidently taken place chiefly in the central portion and by pushing the cortex

outward has formed a sac containing partially laked blood in which there is very little fixed tissue. In the oviduct the hemorrhage has not been as severe and the normal architecture is still recognizable. There is marked deformity, however, due to flooding of the tissue with blood. Very little of the discoloration is due to necrosis. There is no evidence in any of the sections examined of newgrowth tissue or inflammatory reaction.

#### ETIOLOGY

In consideration of the causes of tuboovarian torsion, attention has been called to the fact that the tube and ovary are extremely mobile organs, and a normal tube has a twist of  $90^{\circ}$  (Darner<sup>6</sup>). The peristaltic action of the surrounding intestines has been blamed as well as the changes in the intraabdominal pressure due to coughing, defecation, hiccupping, or trauma to the abdomen (Heil<sup>28</sup>). In Rost's<sup>9</sup> case the child had suffered from marked constipation since birth, evacuation

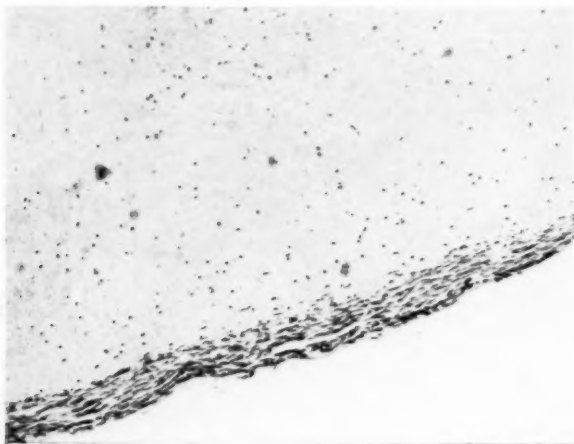


Fig. 3.—Extensive hemorrhage in ovary causing expansion and stretching of tunica and cortex.

being accomplished only after considerable straining, suggesting the possibility of intraabdominal compression. Constipation also produces pelvic congestion. Muscular strain in gymnastic exercise has been mentioned in explanation of the etiology. A long mesosalpinx probably contributes to the ease with which twisting can occur and Thorek<sup>29</sup> has called attention to the tortuosity of vessels in the mesentery, suggesting that the unequal pressure in the arteries and veins might cause twisting. Payr<sup>30</sup> experimentally produced torsion of the splenic pedicle by altering the venous pressure. Sellheim<sup>31</sup> has advanced the rotation theory by which visceral torsion is attributed to habitual body motion or sudden external violence. Moehring<sup>32</sup> states that there is both the torsion which takes place suddenly and chronic rotation which takes a slow course.

Anspach and Norris attach the greatest importance to vulvovaginitis in childhood, flaring up in adolescence and producing an unrecognized early hydrosalpinx,

the tube being only apparently normal. Brown<sup>33</sup> reported a case of severe widespread exudative peritonitis occurring in a child five years old two weeks after a severe vulvitis. From the peritoneal exudate *Streptococcus hemolyticus* was recovered. The tubes were about one and one-half normal size and were apparently the source of the peritonitis, the infection having extended up through the uterus. Severe hemorrhage into the tube would destroy the histopathologic values at the time of examination of the surgical material, rendering a definite statement as to inflammation impossible. Anspach also cites cases of oviduct infection following exanthematous diseases. His case of twisted oviduct in a fourteen-year-old virgin showed salpingitis on pathologic examination. Thorek<sup>29</sup> described a case in which the patient, fourteen years of age, had had an attack of measles and whooping cough two years previously with abdominal pain at that time. The pathologic diagnosis was chronic appendicitis and salpingitis and cystic ovary.

The right side is more frequently involved. Gabe<sup>7</sup> called attention to the right pelvic cavity being larger than the left, due to encroachment of the sigmoid on

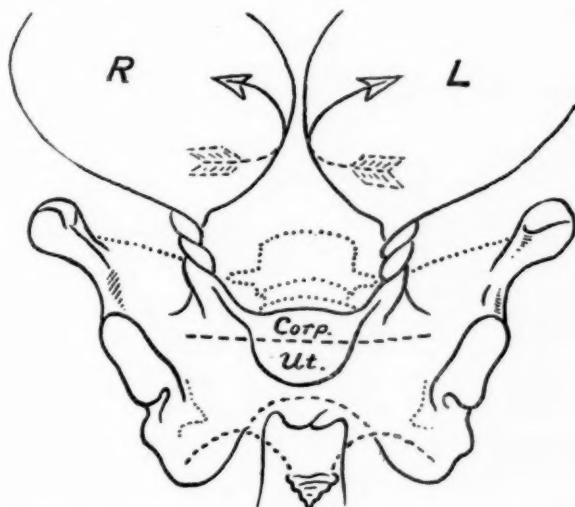


Fig. 4.—Diagram illustrating Küstner's Law. From Küstner's original article.

the left, and as a result, greater movement of the contents of the right half being possible. Besides, he states that peristaltic movement is greater in the cecum and ileum on the right than in the sigmoid. Thorek<sup>29</sup> also mentions the possibility of chronic appendicitis and resulting adhesions in the right pelvis.

Küstner's law is frequently referred to. This law, which deals with the direction in which ovarian tumors twist when torsion occurs, was stated by Küstner<sup>34</sup> in 1891, as follows: "... usually the pedicle of the tumor on the left side is twisted in one direction and a tumor on the right side in the other direction; and indeed the pedicle of the left tumor is usually rotated in a spiral to the right and the pedicle of the right tumor is rotated in a spiral toward the left." The law is usually accepted as applying to normal uterine adnexa as well as tumors. The drawing accompanying Küstner's original article (Fig. 4) shows that in applying the law it is necessary that the observer stand with the pedicle pointing toward him, and he must also understand that the direction of rotation is expressed in terms of his right or left side and not the patient's. It seems as though Küstner's observation could be more concisely stated as follows: *In torsion of uterine adnexa twisting on the right side is clockwise and on the left side, counter-clockwise, when*

*the pedicle points away from the observer.* This is the position in which the surgeon would be most likely to observe such pathology. Judging from the reported cases, Küstner's law is usually followed, and was in our case. However, Schwarzwaller's<sup>35</sup> case was an exception and there have probably been others. As far as we have been able to ascertain there were more complete turns in our case than in any previously reported.

This condition occurs much more frequently on the right side, which makes the differential diagnosis between appendicitis or, in adults, tubal pregnancy, almost impossible.

#### CONCLUSIONS

1. An instance of torsion of the adnexa in a seven-year-old girl is herewith reported. This case is especially rare because the left adnexa were involved, whereas in nearly all of the cases previously reported the phenomenon occurred on the right side. There was apparently no previous disease of the tuboovarian tissue.

2. A careful review of the literature reveals only eighteen authentic cases of torsion of the tube or ovary or both in supposed virgins and with reasonable assurance that previous or coexisting pelvic pathology was absent.

3. It is never possible, however, to state with complete assurance that the adnexa were normal before twisting because the extensive hemorrhage, necrosis and infarction which follow twisting would obliterate evidence of mild inflammation which might be present.

4. The nineteen cases (including the present one) which have been reported, fall in the following age distribution: one at four months, one at four years, and two at six, one at nine two at ten, one at eleven, two at thirteen, two at fourteen, one at fifteen, and four at sixteen years.

5. The maximum age limit of virginity was set at sixteen years, in order to exclude all possibility of venereal infection. This is doubtless too high and perhaps this review should have admitted only those cases where the condition occurred before puberty. Setting the age limit at thirteen years instead of sixteen would have reduced the number of reported cases from eighteen to eleven, eight of both ovary and tube, two of ovary, and only one of torsion of the oviduct.

6. Twisting invariably occurs from right to left on the right side and from left to right on the left side.

7. Because of the rarity of the condition, a correct preoperative diagnosis would be almost impossible.

8. On account of the more frequent right-sided involvement, the incorrect diagnosis of appendicitis would usually be made.

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## EIGHT YEARS' EXPERIENCE WITH ROENTGEN DIAGNOSIS IN GYNECOLOGY\*†

### PNEUMOPERITONEUM AND LIPIODOL IN PELVIC DIAGNOSIS

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ALTHOUGH roentgenography has been employed in diagnosis in almost every branch of medicine and surgery, the gynecologist is about the last to appeal to its aid. True, the methods applicable to pelvic roentgenography are more complicated than those ordinarily used and require the cooperation of the gynecologist during the procedures. However, they are methods of precision and accuracy, and in questions of doubt or differences of opinion they may be used alone or in combination to visualize the pelvic viscera on the roentgen film and thus frequently establish the diagnosis. The methods are safe if ordinary care and skill are employed and if the indications and contraindications are carefully observed. In my experience over eight years, including over 530 cases of pneumoperitoneum and over 200 cases in which lipiodol was used, no accident or complication was encountered. As a result of my experience it is my belief that visualization of the pelvic viscera by roentgen means is of distinct value

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to the gynecologist and should find a place in his diagnostic armamentarium.

The Rubin test has gained a permanent place in the orderly investigation of the childless woman. In addition, its use has been extended to transuterine abdominal inflation for diagnostic pneumoperitoneum. The demonstration of a subdiaphragmatic meniscus of gas by fluoroscopic or roentgenographic means is positive evidence of tubal permeability, and with larger quantities of gas than are needed for the patency test, the abdominal and pelvic organs may be visualized.

When a test for tubal patency is indicated, the method of choice is the Rubin test with carbon dioxide under manometric control. Kymographic tracings and fluoroscopy are interesting observations but are

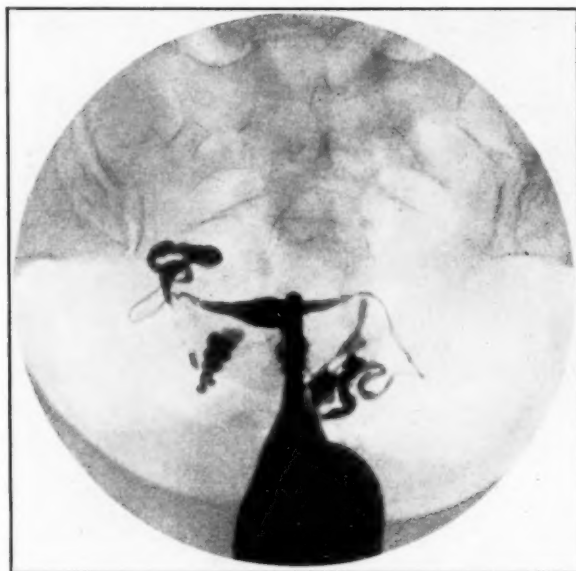


Fig. 1.—Lipiodol instillation. Patent fallopian tubes. "Pearls" of lipiodol in culdesac on right. Tubal sphincters visualized.

not usually essential to the test. If unsatisfactory or inconclusive results are obtained in testing tubal patency, and when diagnostic pelvic roentgenograms are desired, complementary methods employing iodized oil and pneumoperitoneum should be used.

#### ROENTGENOGRAPHY WITH LIPIODOL USED ALONE

Iodized oil as a radiopaque medium has been used by many gynecologists in place of the usual test with gas or air for the determination of tubal patency in cases of sterility. The chief advantage of using this medium is that the filling may be seen fluoroscopically and the results recorded on the roentgen film. "Spill" is shown unmistakably on the film when some of the iodized oil escapes from the free fimbriated end of one or both tubes. (Fig. 1.) In the event of uni-

lateral "spill," the patent side is unquestionably designated by this means. When "spill" is not shown, however, one may not immediately conclude that there is an obstruction. This conclusion may only be reached after due study of successive films taken over a period of hours or upon repeated tests. If the typical triangular shadow in the uterus is obtained and no oil is found in the tubes, there is an apparent obstruction at the uterine cornua. Note that the term *apparent* is here used, and that the uterine cornua and not the isthmus of the tubes is the location of the closure. The closure is most often due to contraction or spasm of the circular fibers in the uterine horns. This location is not so obvious when lipiodol is used alone, but when combined with the use of pneumoperitoneum, it becomes quite clear. The phenomenon of asynchronous contraction of the cornua frequently accounts for unilateral filling of one tube or the appearance of the tubal sphincter on one side. Rudolph and Ivy<sup>1</sup> have recently demonstrated the same phenomenon in a study of uterine contraction in animals. When the uterine cavity is distended with fluid or gas and pressure is maintained, there is a tendency for the uterus to contract down upon its contents. This contraction naturally closes the uterine cornua. If the pressure is released somewhat, relaxation of the uterine muscle follows, and the fluid will pass through the open fallopian tubes, sometimes both at the same time, sometimes each separately with a variable time limit between the two. I have noted cornual contraction and asynchronous relaxation of the uterine horns in a number of cases when observing them over a period of eighteen to twenty-four hours.

The routine procedure usually followed when lipiodol is used is to instil 5 c.c. of the iodized oil through the self-retaining cannula,<sup>2</sup> the patient lying in the dorsal posture. Three films are then taken about five minutes apart, usually with change of posture from dorsal to partial knee-chest position after the first roentgenogram. If one or both tubes fail to contain lipiodol, an additional 2 c.c. of lipiodol are instilled and another film is taken after twenty minutes. Then the cannula is removed or the pressure is somewhat released, and another film taken after twenty minutes. If filling is still incomplete, additional films are taken later on the same and on the following day (the instrument having been removed). When there is no pathologic obstruction present, the eighteen- to twenty-four-hour film will usually record intraperitoneal lipiodol in small scattered irregular quantities in the vicinity of the distal ends of the fallopian tubes or spread about the peritoneal cavity. When there is a pathologic closure, an accumulation of the opaque oil will be recorded which remains constant in location. As was brought out in a previous publication<sup>3</sup> on this subject, when the oily medium enters fluid, as in hydrosalpinx, or encysted or free peritoneal fluid, the oil assumes the form of globules

or "pearls." I have seen the typical "pearl" formation in a number of cases of hydrosalpinx which were later proved at laparotomy.

The use of an iodized oil alone as a means of pelvic diagnosis is definitely limited to scope. To attempt to diagnose tumors, cysts, and tubal pregnancy by this method is apt to lead to error. For intra-uterine pregnancy, it is meddlesome, dangerous, and to be avoided, as should all other methods of intrauterine instrumentation. Characteristic alterations in the shape of the filled uterine cavity have led many observers to diagnose fibroids, polyps, bicornuate and double uteri. This may occasionally be satisfactorily done by taking roent-



Fig. 2.—Pregnancy at six weeks. Transabdominal pneumoperitoneum.

genograms with the patient in various postures, but the evidence obtained by merely filling the uterus is often incomplete and the resulting diagnosis inaccurate.

#### PNEUMOPERITONEUM IN PELVIC DIAGNOSIS

When a liter of  $\text{CO}_2$  is introduced into the peritoneal cavity either by the transuterine or transabdominal route, and the patient is placed in the partial knee-chest posture, as first described by Peterson,<sup>4</sup> satisfactory roentgenograms of the pelvic viscera can be obtained. The uterus, ovaries, fallopian tubes, and bladder are regularly shown, and the round ligaments are sometimes seen. Thus, the presence or absence of pelvic viscera when in question, hypoplasia, or any alteration in their size, shape, or density is demonstrable. Adhesions of the viscera to each other or to other organs can be shown unless the whole pelvis is obliterated by the inflammatory process. For example, in a case of apparent absence of the vagina in a young woman of twenty-

three years, in whom rectal palpation yielded unsatisfactory findings, a transperitoneal pneumoperitoneum was done and roentgenograms were taken. The films disclosed a normal uterus, ovaries, and tubes. It was thus clear that the vagina was present but undoubtedly oc-

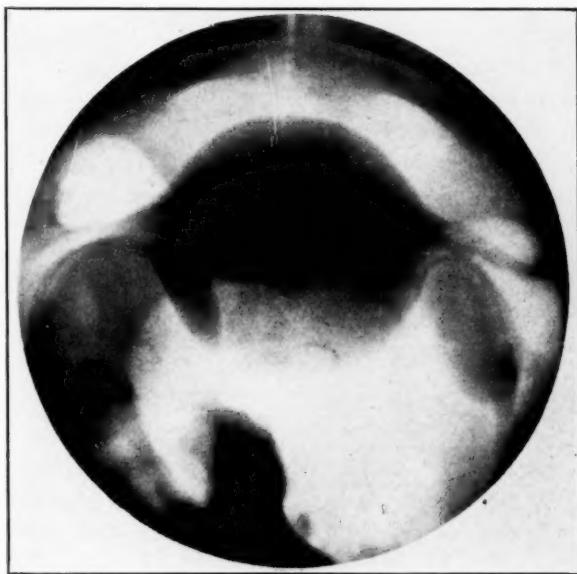


Fig. 3-A.—Pregnancy at six weeks complicated by dermoid cyst. Transabdominal pneumoperitoneum.

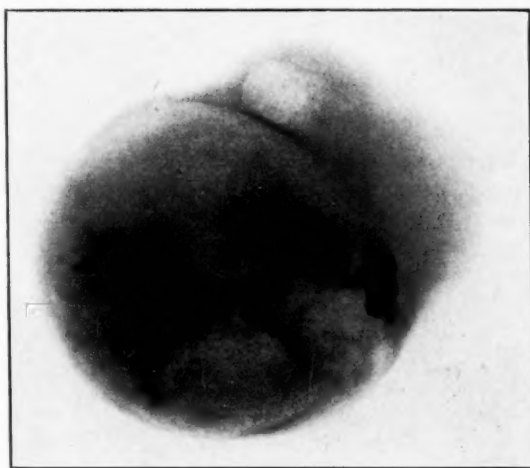


Fig. 3-B.—Dermoid cyst removed during pregnancy.

cluded in early life even though no history of vaginitis was obtainable from the patient or her family. At operation for vaginal reconstruction a pocket of vaginal mucosa was found about the cervix, and following this downward considerable mucosa was uncovered which was utilized in restoring the vaginal canal.

In the diagnosis of early uterine pregnancy, from five to six weeks (Fig. 2), a characteristic picture is obtainable by pneumoperitoneum and no harm results from the transabdominal inflation. By this means intra- and extra-uterine pregnancy, lutein, and other cysts of the ovary may be graphically differentiated. Small ovarian cysts (under 12 cm.) can be clearly shown, and frequently the kind of cyst may be directly recognized. In a young woman suffering from severe vomiting in pregnancy at six weeks, a left-sided cystic swelling was found. Transabdominal pneumoperitoneum revealed a pregnancy of six weeks complicated by a dermoid cyst. (Fig. 3.) The dermoid was removed and pregnancy continued undisturbed. Because of their increased density and smooth capsule, fibroids are usually visualized on the roentgenogram. Their size, if not too large, their number and distribution can be shown. Small fibroids often present greater diagnostic problems than large ones, and these are easily demonstrable by pneumoperitoneum. When fibroids or cysts are associated with

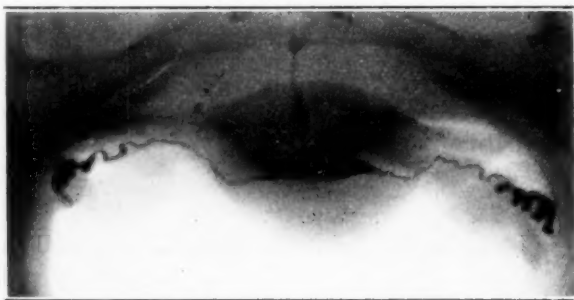


Fig. 4.—Lipiodol and pneumoperitoneum combined. Uterus, tubes, and ovaries clearly visualized. Lipiodol fills uterine cavity and tube lumens.

early pregnancy, the roentgen film after induction of pneumoperitoneum is of great value. The technic and armamentarium<sup>5</sup> for this diagnostic procedure has been previously published.

#### VISUALIZATION OF THE PELVIC VISCERA WITH LIPIODOL AND PNEUMOPERITONEUM

In many cases of difficult or doubtful diagnosis, except where lipiodol instillation is contraindicated, such as in bleeding from the uterus, pregnancy, infected uteri, virgins, etc., the two methods mentioned above may be combined. By this means the maximum information concerning the pelvic status may be recorded on the roentgenogram. (Fig. 4.) I have utilized this combination in over 200 cases in the past three years, and I believe that in properly selected cases and with a careful technic it is of greater value than either method used alone. In some instances lipiodol alone will give all the information that is desired; i.e., that the fallopian tubes are patent, and that the uterine cavity is normal in shape and size. In many



cases, by pneumoperitoneum alone, either induced by the transuterine or transabdominal route, a satisfactory film is obtained for intrapelvic diagnosis. By the combined method of pelvic visualization, however,



Fig. 5-A.—Lipiodol instillation. Double vagina. Cannula in each cervical os. Suggestive of double uterus.



Fig. 5-B.—Lipiodol and pneumoperitoneum. Single septate uterus outlined by the gas (same patient as in Fig. 5-A.)

one method often complements the incomplete information obtained by the other, and all of the information obtainable is recorded on the

roentgen film. For example, in two cases where lipiodol instillation gave the same picture; i.e., that of cornual obstruction, one was shown by the addition of pneumoperitoneum to be entirely free from pathologic change, the adnexa being clearly outlined on the film, while the other appeared definitely pathologic. The tube and ovary were matted in the latter, the inflammatory damage accounting for the obstruction. Without the addition of the pneumoperitoneum, both cases might have been diagnosed as pathologic closures.

Again, in a patient with double vagina and two ora in the cervix, lipiodol filled two separate uterine cavities as in double uterus. Pneumoperitoneum revealed a single (fused) septate uterus. (Fig. 5.) Similar results obtained with lipiodol alone have been reported as

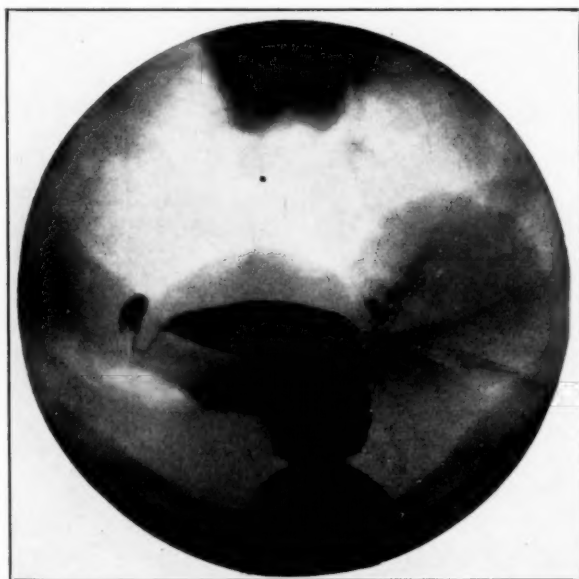


Fig. 6.—Lipiodol and pneumoperitoneum. Arrest of lipiodol in midisthmus of both tubes. Left ovarian cyst. Right adnexa matted.

double uterus<sup>6</sup> in the literature. Another case well illustrates the value of visualization of the pelvic viscera by the combined method. The patient came for a sterility investigation. The only significant datum in the history was a suspension operation for retroversion six years previously at which time the pelvic organs were found normal. Patency test performed with the Rubin apparatus at the office recorded pressures up to 200 mm., with the characteristic kymographic tracing of tubal obstruction. A repeated test at the hospital revealed the same result; therefore 5 c.c. of lipiodol were instilled into the uterus and transabdominal pneumoperitoneum was induced. The films (Fig. 6) reveal a normal uterus, apparent matting of the right tube and ovary, and a left ovarian cyst about 6 cm. in size. The lipiodol fills the uterine cavity and enters both tubes but is arrested symmet-

rically about an inch from each uterine cornu. A series of films taken over a period of eighteen hours disclosed that the points of obstruction were constant. Tubal obstruction in the midisthmus of each tube is visualized here, as well as a left-sided ovarian cyst. Both of the above conditions obviously developed as postoperative sequellae. Whether the fallopian tubes were suspended by mistake, or became adherent at the points of round ligament suspension is a matter of speculation. The result was a bilateral tubal occlusion. The lipiodol indicates the points of obstruction. The pneumoperitoneum defines the location of the closures and visualizes the complicating ovarian cyst.

#### SUMMARY

1. As proof of a successful Rubin test the subdiaphragmatic meniscus may be demonstrated fluoroscopically and roentgenographically.

2. By the use of lipiodol or other radiopaque liquid, the Rubin test may be complemented or supplemented and the result recorded on a roentgen film. This is of value in recording "spill" in cases of tubal patency, in formation of "pearls" in the presence of fluid, and in defining points of tubal obstruction. Uterine cavity abnormalities may also be recorded. The intrauterine instillation of these substances is contraindicated in pregnancy because of the danger of inducing abortion.

3. By the use of pneumoperitoneum and suitable roentgen technic the female pelvic viscera may be clearly visualized on the roentgen film. Any condition altering the size, shape, density or relationship of these organs, as well as tumors, pregnancy, and adhesions can be diagnosed.

4. By the use of the two above methods together the maximum information concerning the pelvic organs is obtained. The procedure is a safe and simple one if ordinary care and sufficient time are employed. In my series no accidents or complications have occurred in over 530 cases of pneumoperitoneum and 200 cases in which lipiodol and pneumoperitoneum were combined.

5. In settling differences of opinion and as a matter of permanent record of the pelvic status, roentgenograms with these methods are of great value.

6. Visualization of the pelvic viscera by roentgen methods has a distinct value in teaching gynecology.

The cooperation of Dr. R. A. Arens, roentgenologist at Michael Reese Hospital was indispensable in this study and is hereby acknowledged with thanks.

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## TRAUMATIC SEPARATION OF THE SYMPHYSIS PUBIS

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**S**EPARATION of the symphysis pubis or rupture of the pubic joint occurs in pregnant women as a result of an external injury or labor. Separation rarely occurs in nonpregnant women, and when it does, it is usually associated with other injuries. It may occur in the pregnant woman before, during, or after labor. The majority of cases associated with pregnancy occur during labor, and are associated with some operative procedure, although spontaneous rupture may occur. Separation occurs infrequently in the pregnant woman according to reported cases.

Braun v Fernwald observed separation of the symphysis pubis in 1 in 10,000 deliveries, Schauta, 3 in 30,000, Fritz Kayser, 3 in 94,000, Morgan, 2 in 87,000, and Sloane Maternity, 3 in 4,500. In 1898 Paul Rudeaux collected 98 cases, Kehrer collected 100 cases up to 1915. It is estimated as occurring in about 1 out of 25,000 cases. Wishner and Mayer saw 5 postpartum cases in a year and were informed of 6 more. They conclude that it is not as rare as supposed, but often overlooked.

A closer examination of the literature shows that many of the cases reported as rupture of the symphysis pubis are really cases of injury to the back of the pelvis as well as the symphysis pubis. Sacral pains are almost always present. Surely pain in the sacral region has little to do with rupture of the symphysis pubis itself, but depends most likely on an injury to the sacro-iliac articulations. Moeltgen published a case in which there was a separation of the symphysis pubis to the extent of 6 or 7 cm. according to the x-ray. This is unthinkable without injury to the sacro-iliac articulations.

From autopsy findings Westerborn found that if the urogenital trigone holds, it offers sufficient resistance and there is no separation of the pubic bones. From his studies he concludes that a small diastasis of the symphysis pubis can take place without injury to the sacro-iliac articulations. A separation of 40 to 80 mm. produces a bad tear in the sacro-iliac articulations. A separation or dissemination of the lower anterior part of the sacro-iliac articulations up to 10 mm. can take place without rupture of the interossei ligaments. As long as these strong ligaments hold, the joint holds together, and because they do so often hold, the diastasis of the symphysis pubis seldom becomes great. Wishner and Mayer similarly conclude that one or both sacro-iliac joints are involved usually to the extent of tearing of the anterior ligament of one or both sacro-iliae.

According to Gallet-Duplessis (1893) a separation of the symphysis of 35 to 40 mm. can occur without damage other than a trifling separation of the anterior ligament of the sacro-iliac articulations. Savor-Kayser and Ohlfeld claim that injury to the sacro-iliac articulations occurs with the least separation of the symphysis pubis. Kehrer claims a separation of 3 to 4 cm. can occur without injury. B. Zweifel and Mullerheim state that a separation of 6.5 cm. can occur without injury to the sacro-iliac articulations but a separation of 7 cm. produces a tearing of one sacro-iliac articulation.

The separation may be considerable, but usually it is not great. Westerborn states that it may be from 1 to 7 cm. Maisannet had a case with a separation of 9 cm. and Lambotte one with a separation of 10 to 12 cm. The separation is said to take place between cartilage and bone as in an epiphyseal separation and not through the cartilage. Breus and Kolisko assert that the cartilage is always torn from one pubic bone; but this, however, is not confirmed. Guibe found at autopsy an example of rupture of the cartilage with pieces adherent to both sides. Murad and Westerborn each published a similar case. One cannot determine this from x-rays, but an operation is necessary to determine the site of separation.

Traumatic separation of the symphysis pubis may be caused by falls, severe strains, and forcible separation of the thighs. Direct, actual force from in front and below the symphysis as well as through forcing the pelvis in front in a sagittal or oblique direction can cause separation. In horseback riding the withers of the horse may serve as the separating wedge. Traumatism through interior or exterior force may cause rupture. Cases have been reported in which, in the opinion of the author (Westerborn), the separation originated through muscle action, i.e., a man who slid with a foot and stood as if about to fall backwards, made a fencing movement, and received the injury. Cases are seen as a result from a fall downstairs or from a wagon. Falling on the buttocks may produce it. DeLee estimates it takes a force of 400 to 2600 pounds to disrupt the pelvic girdle.

Certain causes predispose to separation, as disease of the pelvic joints, disproportion, normal increased mobility during pregnancy, or repeated pregnancies. According to Kehrer there may be a softening or development of cavities in the pubic cartilage and capsule. Caries, rachitis, osteomalacia, chronic arthritis, trauma during pregnancy, and congenital weakness may predispose toward rupture. The majority of cases seen during delivery are due to injudicious methods of delivery. Disproportion helps to expand the pelvis. According to DeLee, the joint is sprung in 75 per cent of operative cases. Sixty-seven per cent of his (DeLee's) cases occurred in forceps deliveries. This may be done by pulling upward too soon in a forceps operation, the head acting as a wedge. It may occur in rare instances in spontaneous deliveries, particularly if the pelvis is contracted in its lower portion. Seventeen of Kehrer's 100 cases occurred in spontaneous deliveries.

In a series of 500 cases, Cantin found an increased mobility in 98 per cent over that of the nonpregnant. Sixteen per cent had only 1 mm. separation. There were symptoms in 15 per cent and in 70 per cent of those giving symptoms there were changes in the gait. Lynch found that widening of the sacrosciatic spaces was almost a constant phenomenon. Only one of his cases showed marked separation of the symphysis pubis, and this returned to normal in fifteen months.

*Prognosis.*—Rupture of the symphysis pubis, per se, is not serious as a rule. With complications, it carries the risk of these complications, hence there may be a considerable mortality. Healing usually takes place without difficulty. Cohn cites a series of 15 cases in which 6 had rupture of the bladder, one clot and suppuration with prompt recovery on incision; 8 cases recovered, 4 complete, 3 nearly perfect, and one not stated. Union is satisfactory as a rule in traumatic cases and function is good. According to Schauta and Duhrssen, one-third have fever and sepsis. Rudeaux and Struff report 38 per cent as having suppuration. Some die from emboli. There is rarely a return of the rupture and subsequent labors are usually easy. If suppuration occurs, ankylosis may result. Injuries to adjacent viscera, primary hemorrhage, shock, and later sepsis bring the mortality to about 35 per cent.



*Treatment.*—The patient should be put to bed for from eighteen to ninety days. A pelvic girdle of adhesive or a belt that laces should be applied and kept on for from four to six weeks or the patient suspended in a hammock or sling in the Balkan frame as the weight of the body produces a strong cohesive force. Wishner and Mayer use a somewhat similar type of apparatus as shown below. The knees should be kept together for a week with a pillow placed under them to prevent a sag on the pelvis. A Bradford frame may be used to facilitate nursing care. The patient should be kept recumbent for four to six weeks. Crutches should be used when the patient first starts to walk. If an operation is necessary to get approximation, it usually is simple but it is seldom required. Functional cure is possible with slight persistent separation. Beach reports a case with 3 cm. separation and definite mobility without symptoms.

*Effects on Labor.*—Some authors consider it advisable to terminate the pregnancy by inducing an abortion or premature delivery, but as a rule this is not justified.

The effect of rupture of the symphysis pubis on labor is the same as symphyseotomy. The capacity of the canal is considerably increased, particularly in the transverse and oblique diameters and to a less extent in the anteroposterior diameter. According to Williams, it is usually stated that the conjugata vera becomes 2 mm. longer for each cm. of separation at the symphysis pubis so that in a gap of 5 to 6.5 cm. the increase would aggregate 12 to 13 mm. A normal labor may be hindered by reason of callus or contraction after healing.

Emgstram had a patient, six months pregnant, who had had tenderness and weakness in the region of the symphysis pubis for five weeks. She fell and had to go to bed because of pain. Later the pain disappeared and somewhat later there was mobility and weakness. Delivery of a large child was spontaneous at term without especially severe pain in the symphysis pubis.

Boorstein reports a case of spontaneous separation of the symphysis pubis at eight months. The patient was a para iv and had had 3 spontaneous labors. She had pain in the symphysis pubis when turning in bed, but no pain while at rest and no dysuria. Adhesive was applied. The delivery was normal and without additional pain. The pain lasted for about two days postpartum.

The 2 cases reported below have been seen on the Obstetrical Service of the Strong Memorial Hospital and present a number of facts of interest.

CASE 1.—Mrs. G. W., a twenty-nine year old para v, was admitted to the Emergency Division on May 6, 1928 complaining of pain and injury in the region of the pelvis. She gave a history of stumbling and falling on her knees on a carpet in her home the day before while carrying her baby in her arms. She experienced a sudden, sharp pain in the front of the pelvis and was unable to get up. She was helped to bed. The pain increased after a few hours and she was scarcely

able to lift her left leg. Later there was backache. The patient was about two weeks from her expected date of confinement. The pregnancy had been normal except for slight edema of the feet and ankles and slight dyspnea. She had voided several times before admission without blood in the urine. Her past history was negative. She had had 4 spontaneous term pregnancies with easy labors and normal puerperia. Physical examination was negative except for the abdomen and pelvis. There was a fair-sized child in R.O.P. with the head engaged. The fetal heart was normal. There was pain over the symphysis pubis when pressure was made. Compression of the crests of the ilium caused pain in the region of the symphysis pubis. Both extremities could be moved voluntarily, the left with more difficulty than the right. There was pain in the lumbar region and around the symphysis pubis on moving the extremities. A catheterized specimen of urine was negative.

Stereoscopic picture of pelvis on admission showed a traumatic symphyseal separation of about 2.5 cm. (Fig. 1). The right pubic bone was considerably higher than the left. The fetal head was deep



Fig. 1.

in the pelvis. The sacro-iliae could not be seen because of the fetal head. The patient was seen by Dr. Schwartz who advised that she be placed in a hammock with a Balkan frame.

The hammock was suspended from the Balkan frame on each side by a rope as shown through 3 pulleys attached to the frame. Weights were attached to the ends of the ropes of the head and foot of the bed. The ropes were fixed at the points of attachment to the hammock. The hammock just cleared the bed.

After admission the patient had definite pain with soreness over the abdomen suggesting labor pains and the next day was nauseated and vomited. This nausea and vomiting persisted for about ten days to such an extent that the patient was unable to retain anything by mouth so that it was necessary to give saline infusions and intravenous glucose. Her temperature was slightly elevated, 37.8° C. being the highest. The pulse became rapid, 100 to 120, and she had a slight chill. She complained of backache most of the time. Blood chemistry three days after admission showed a CO<sub>2</sub> combining power of 25.5 per cent; uric acid, 6.85;

chlorides, 546; sugar, 83.2; and nonprotein nitrogen 40 mg. per 100 c.c. of blood. The changes in the blood chemistry were due to the starvation and dehydration. Her condition gradually improved and on May 15 the  $\text{CO}_2$  combining power was 48.5 per cent. The blood pressure was 130/78 and the pulse slower.

On May 19, thirteen days after admission, the patient was delivered spontaneously of a 4610 gm. female child after an easy five hour labor. The second stage was ten minutes. The biparietal diameter of the child's head was 10 cm. Her symptoms cleared up after delivery. Following delivery, the patient was not suspended in the hammock at night. X-rays the day of delivery showed approximately the same amount of separation of the pubic bones as on admission but the alignment was better. There were suggestive changes along both sacro-iliac joints. The Balkan frame was removed a week later and the patient kept flat in bed. She had slight discomfort in the region of the symphysis pubis for a few days, but otherwise was quite comfortable. She had no difficulty in voiding urine.

The patient was discharged from the hospital one month after admission. Examination at the time of discharge showed the pubic bones to be in good apposition and there was no tenderness on pressure. Vaginal palpation revealed no

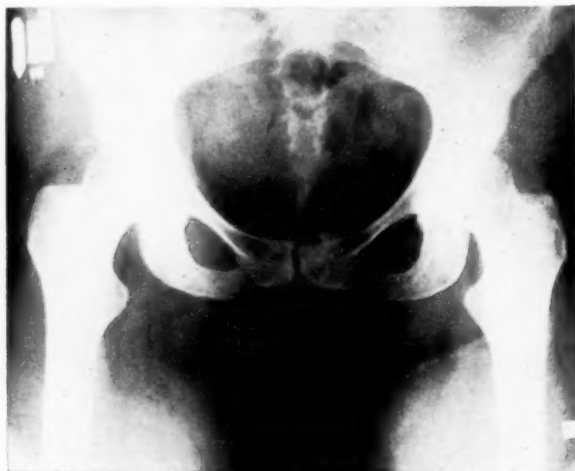


Fig. 2.

evidence of callus formation along the pubic rami on either side. Active movement of the legs caused no discomfort and no apparent motility in the joint. Passive motion of each leg separately, particularly if the thigh was slightly adducted, revealed a slight degree of motion in the symphyseal joint. The prognosis in this case seemed excellent. X-rays taken at this time showed the pubic bones to be in good alignment with a separation between the 2 ends of 1 cm. The patient complained of slight discomfort in the right sacro-iliac joint and palpation over both sacro-iliac joints gave one the impression that they were a little wider than normal.

She remained in bed two weeks after going home and returned for observation two weeks later, at which time she felt well. Examination showed a slight notch at the symphysis pubis but no pain or callus. There was slight motility on passive motion of the thighs, not painful. Locomotion was satisfactory. The patient was seen again 2½ months later and felt perfectly well. X-rays at this time showed the distance between the pubic bones to be approximately within normal limits. There were shadows of increased density suggesting callus formation along the superior aspect of the left pubic ramus and also along the inferior aspect of the right pubic

ramus. The callus which had formed was probably due to periosteal injury rather than actual fracture across the pubic bones (Fig. 2).

The patient was next seen a year later at which time she was 5 or 6 months pregnant. There were no symptoms referable to the symphysis pubis except a pruritus. There was a palpable depression along the symphysis pubis.



Fig. 3.



Fig. 4.

X-rays at this time showed the same proliferative change at the superior margin of the left pubic ramus and along the lower margin of the right lower pubic ramus. There was about twice the separation of the symphysis pubis as noted on the last examination, or 11 to 12 mm.

Later in the pregnancy the patient had some difficulty in locomotion and definite palpable separation of the symphysis. These symptoms cleared up. No support or girdle was used.

The patient was delivered spontaneously at term of a 4800 gm. child after a nine-hour labor with a second stage of forty-five minutes. The biparietal diameter of the child's head was  $10\frac{1}{2}$  cm.

Two days later x-rays showed a marked farther separation of the symphysis pubis. The width measured 20 mm. The appearance of the pubic bones was unchanged (Fig. 3).

The convalescence was uneventful and afebrile. The separation was still present when the patient was discharged from the hospital, and there was some movement when the thighs were forcibly rocked and abducted.

X-rays at the end of the puerperium showed the separation of the pubic symphysis to be very much less. As measured on the film it was less than 1 cm.,



Fig. 5.

about 8 or 9 mm. There was a ring pessary in place for a retroversion. The separation (Fig. 4), was much less on palpation and no abnormal motion could be elicited. The patient felt well except for some backache at times. Correcting the retroversion relieved the backache.

CASE 2.—Mrs. G. K., a twenty-five year old para iii, was at term when first examined. She had had 2 full-term easy spontaneous labors. Her past history was of interest due to the fact that she had received a fracture of the pelvis eighteen months before in an automobile accident. The fracture had been treated with a body cast and the functional result was excellent. The patient had no symptoms from the fracture until two months before admission. At the time of admission on July 1, 1929, she was scarcely able to stand without holding to something. The pelvic measurements were normal. Stereo and lateral views of the pelvis taken on July 2, 1929 showed a complete fracture of the superior ramus of the left pubic bone several cm. from the symphysis pubis. There was also a line crossing the inferior wings of the ischial bone suggesting an additional frac-



ture. The most marked mal-alignment had occurred at the symphysis pubis. A complete separation had occurred at this point and the left pubic bone was approximately 2 cm. higher than the right. The deformity produced was marked. The left pubic bone was displaced posteriorly to some extent, though not so much as the upward displacement. The fracture of the symphysis pubis was such that a large bony fragment measuring approximately 3 cm. in its longest diameter was situated free in the soft tissue. Situated relatively low in the pelvis was the fully formed head of the fetus (Fig. 5).

On July 8, 1929 the patient was delivered spontaneously of a 4130 gm. male child after an eight and three quarter hours' labor. Her puerperium was normal. She was discharged from the hospital on the fourteenth day. There were no symptoms from the fracture of the pelvis at the time of discharge (Fig. 6).

X-rays taken ten days postpartum showed that the relationships were essentially those noted prior to delivery. There was a large piece of callus superior to the right pubic ramus, which apparently was directed toward the left pubic bone though



Fig. 6.

it had not extended to reach it. There was a piece of callus near the left inferior ischial ramus which did not appear to come in contact with the bone at any point. The joint space in the sacro-iliac joints was several times the normal width. No definite slipping was apparent. The changes in the sacro-iliac joints were probably due at least largely to the recent pregnancy.

The patient when seen a month later was symptomless.

*Comment.*—The first case is one which was at first thought to be an example of simple rupture of the symphysis pubis, but as was later shown had possible injury to the pubic rami and questionably so to the sacro-iliac joints. The sacro-iliac joints presented little if any change over the period observed. The cause of symphyseal separation was probably a combination of indirect violence and muscle action. The child's head may have been jarred into the pelvis with enough force to be an additional factor. The fact that the patient was a young

multipara was probably a predisposing cause, as it has been shown that the maximum amount of softening and relaxation of the pelvis joints occurs in such cases.

The separation, as measured from the x-ray, was about 2.5 cm. This is within the limits given by several authors in which no more injury than separation of the symphysis pubis results if more than a slight degree of separation takes place. The backache in the region of the sacro-iliac joints indicates that there must have been injury to these joints, even though not definitely shown by the x-rays.

The gastrointestinal symptoms which were present for a time are not so easily explained. No abdominal injury was noted. The pain complained of was not associated with uterine contractions. Injury to the sympathetic system may produce such symptoms as observed in this patient, so that such a cause may be offered as an explanation of the gastrointestinal symptoms.

The injury to the pelvis certainly had no ill effects on the labor which was easy and not more painful than would be expected without such injury. The second labor was somewhat more difficult, but the child was also larger. This case, then, can be classed as one of rupture of the symphysis pubis and possible injury to the sacro-iliac joints as well as the pubic rami in a twenty-nine year old multipara who had 2 uneventful labors and excellent recovery with conservative treatment.

The second case is an example of a case showing that separation of the symphysis pubis and fracture of the pelvis does not necessarily interfere with a normal spontaneous labor. Also, that such an injury may have little effect on subsequent labors.

Both patients had children of excessive size—those of the first patient weighing 4610 and 4800; and the child of the second patient 4130 gm.

The Balkan frame and hammock used on the first case was a very satisfactory mode of treatment. It was comfortable for the patient and her weight when suspended in the hammock gave sufficient cohesive force. She was free with certain limitations to move in bed and the nursing care was made easier.

#### CONCLUSIONS

1. Separation of the symphysis pubis without further injury to the pelvis is very rare.
2. If there is more than a small amount of separation there is further injury to the pelvis, usually in the sacro-iliac articulations.
3. Rupture of the symphysis pubis, per se, is not serious as a rule and healing is usually satisfactory.
4. Rupture of the symphysis pubis, as a rule, does not necessarily produce a deleterious effect on labor and operative measures are not usually indicated.

5. Subsequent pregnancies may cause a recurrent partial separation but, again, not necessarily affecting labor and the end-result will usually be satisfactory.

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## PRIMARY CARCINOMA OF THE FALLOPIAN TUBE

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**T**UMOR growths originating in the fallopian tubes are not very frequently encountered and because of the great similarity in signs and symptoms of such tumors to other more common pelvic conditions, the diagnosis is seldom made clinically prior to operation and pathologic examination of the specimen. The literature of the subject has been fully reviewed by Wechsler<sup>1</sup> and more recently by Callahan<sup>2</sup> and Watkins.<sup>3</sup> It is the purpose of this paper to add another case to the literature and also discuss some of the salient features which such cases present.

## CASE REPORT

A. D., aged fifty-five years, American, housewife, was admitted on August 15, 1930, to the Missouri Baptist Hospital complaining of vaginal discharge, nervousness, and palpitation of the heart. The patient had had no previous severe illnesses or operations. She had had three full-term pregnancies, and there had been no miscarriages or abortions. The menstrual cycle was normal in every respect until the onset of the menopause five years ago. Since then she developed symptoms characteristic of the climacteric.

The onset of the present illness dates back to two years ago when she gradually developed a watery vaginal discharge. The discharge, intermittent and scanty at the start, had become more profuse and continuous during the past five months; it turned sanguinous during the last three weeks. The discharge was odorless but rather annoying on account of its frequency and the need of constant changing of vaginal pads. The appetite had been good although she believes that she lost a small amount of weight. There had been no abdominal pains or soreness; she was somewhat constipated and resorts daily to mild cathartics to secure constant bowel action.

Physical examination on admission to the hospital revealed a well-developed and fairly well-nourished white female displaying a moderate degree of pallor of the mucous membranes. Heart and lungs were normal; blood pressure was 220/110.

Vaginal examination disclosed a cystocele and a small erosion of the cervix. The uterus was small and retroplaced; the adnexa were not palpable.

*Laboratory Findings.*—Red blood cells 3,500,000, white blood cells 8,500, and hemoglobin 65 per cent. Blood nonprotein nitrogen 30.0 mg. per 100 c.c., blood sugar 0.085 per cent. The urine showed a few hyaline and granular casts.

A clinical diagnosis of a probable malignancy of the uterus was made. Operation was performed on August 16, 1930, under spinal anesthesia. The abdomen was opened through a midline incision extending from the symphysis pubis to the umbilicus. The uterus, both ovaries, and the right fallopian tube were found to be normal in appearance. The left fallopian tube was enlarged in its distal third and had the form of a club-shaped tumor, the latter measuring about 5 cm. in diameter. The tumor was slightly adherent and easily separated from the posterior parietal peritoneum. The fimbriated end of the tube was occluded and the serous surface of the enlarged portion was injected and discolored. The gross appearance of this tube at the time of the operation was indistinguishable from a

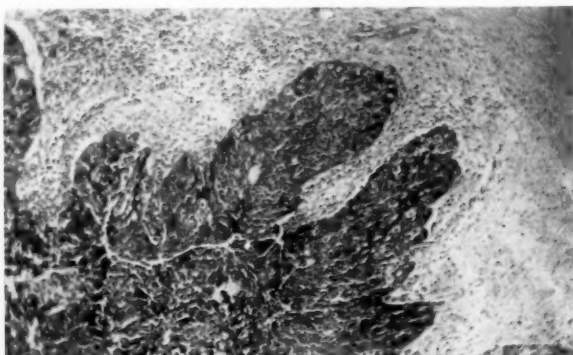


Fig. 1.—Low power photomicrograph showing the microscopic appearance of the tumor. Note the papillary projections of the tumor and the associated inflammatory changes in the tubal wall.

chronic inflammatory process, but due to the fact that the lesion was confined to only a portion of one tube, it aroused the suspicion that it might be malignant. A panhysterectomy was therefore performed and the abdomen closed in the usual manner.

*Pathologic Findings.*—The uterus, both ovaries, and the right fallopian tube were normal in appearance. The distal portion of the left tube was enlarged and measured 5 cm. in diameter; the fimbriated end was completely closed. The serous surface of the tube presented a purplish discoloration with a few roughened areas due to adhesions. Cut section through the enlarged portion of the tube revealed numerous pedunculated and sessile papillary growths arising from the tubal wall. The lumen was filled with necrotic debris that had a brownish discoloration. Grossly, this tumor growth appeared as malignant.

*Microscopic Observations.*—Sections taken from the uterus, both ovaries, and the right fallopian tube revealed no histologic abnormalities. Sections taken from the left tube containing the tumor mass disclosed a very thickened wall apparently due to overgrowth of fibrous tissue. The latter was infiltrated with numerous inflammatory cells. The normal mucosal folds were entirely absent and their place was occupied by papillary outgrowths that projected into the lumen of the tube.

The central friable portion of the tumor was composed of papillary chains of cells which in places were so crowded together as to lose their original papillary pattern. The cells were mostly of low columnar type. A striking feature of these papillary projections was the absence of the centrally formed fibrous tissue core which is so commonly seen in such tumors. (See Fig. 1 and 2). In addition to the main papillary tumor, there were also found areas composed mainly of solid nests of cells which carried an insignificant amount of connective tissue stroma. These areas lacked any particular architectural structure and were composed essentially of large polygonal and oval or spindle-shaped cells, that had a clear faintly staining cytoplasm and hyperchromatic nuclei. Mitotic figures were very numerous. All the coats of the tube were invaded by tumor tissue, the latter reaching as far as the serosal surface. A great number of the lymph spaces were found plugged with nests of tumor tissue but the blood vessels escaped any such invasion.

#### DISCUSSION

The clinical features presented by this case are very similar in character to those described in the literature and require therefore very little additional comment. The disease occurs as a rule in indi-

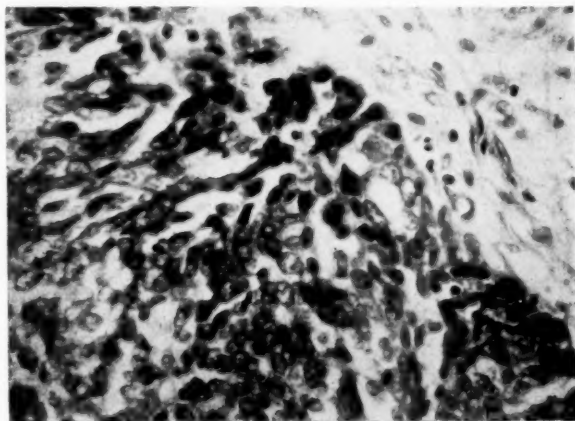


Fig. 2.—High power photomicrograph of same tumor shown in Fig. 1. Note the size and shape of the cells and the numerous mitotic figures in the section.

viduals at or past the menopause which is the age incidence of all other types of malignant tumors. It manifests itself in a variety of form and presents such a confusing and indefinite symptom complex as to render a clinical diagnosis very difficult. Because of the close similarity of the disease, both in signs and symptoms to other more common pelvic conditions, it is very frequently diagnosed either as a tubo-ovarian or uterine neoplasm or as a pelvic inflammatory condition. The frequent occurrence of second inflammatory changes in the tumor complicates still further the clinical picture and masks the true condition of the disease. The commonest symptoms, however, which these patients present are watery or serosanguinous vaginal discharge with or without abdominal pains. Both the abdominal pain and the vaginal discharge may vary in character and severity in different individuals



or in the same individual at different epochs of the disease. The discharge may thus be scanty or profuse, continuous or intermittent, watery, serosanguinous, hemorrhagic, or purulent, while the pain may be dull, achy, or cramp-like in character. Depending upon the size and position of the tumor in the pelvic cavity, there may occur either urinary or intestinal disturbances such as frequency and urgency of urination or constipation and obstipation. In spite of the usual malignant anatomic characteristics of this tumor, marked loss of weight and cachexia are very seldom observed, although undernourishment and anemia are more commonly seen.

The physical findings are not at all pathognomonic of the disease and very often are indistinguishable from other pelvic conditions. Occasionally a tumor mass may be felt on either side of the uterus or in the pouch of Douglas. The size of the tumor varies from the thickness of the little finger to that of a large mass which may fill the abdomen and reach as far as the xyphoid process. The tumor is either freely movable or fixed in position, all depending upon its invasive properties or upon secondary inflammatory changes in the tumor, that may cause immobilization through the formation of adhesions.

The commonest site of origin of the tumor is from the middle or distal third of the tube. When formed, it may be unilateral or bilateral. The abdominal ostium is very frequently closed, most probably by the tumor itself.

Microscopically, two common varieties of the tumor are recognized, namely, (1) papillary and (2) papillary-alveolar. Various modifications of these two patterns are sometimes seen in different tumors. The normal mucosal folds are usually replaced by arborescent branching, the latter consisting of a central fibrous tissue core upon which is mounted one or several layers of cuboidal epithelium. The cells vary in size and shape and may assume either a round, polyhedral or oval form; the cytoplasm is usually clear and the nucleus hyperchromatic. Mitotic figures may be very numerous or very scanty; occasionally they are entirely absent. The central portion of the tumor mass very frequently undergoes necrosis and becomes infiltrated with the various inflammatory cell elements. Such necrotic pieces of tumor may be thrown off into the lumen of the tube and completely occlude it. Metastasis occurs very often in the retroperitoneal lymph nodes and in adjacent structures especially the ovaries and uterus.

The etiology of this disease has been disputed and subjected to a great deal of discussion. Many observers attributed the cause of this tumor growth to irritation resulting particularly from long-standing inflammation, but since the true etiology of the disease is not determined, one is reduced to speculations regarding the mode of dependence of the tumor process upon the irritant. Sanger and Barth<sup>4</sup> believed that salpingitis was the essential forerunner and causative agent in the genesis of the disease, while Doran<sup>5</sup> and others believed that



these growths were secondary to malignant changes taking place in a benign papilloma. The upholders of the former theory base their arguments mainly on the finding of inflammatory changes in these affected tubes. Such evidence, however, must be taken with a great deal of caution in interpreting its bearing on the origin of carcinoma. It is true that chronic salpingitis is very often found in association with this disease but this does not prove that the neoplasm is a result of the inflammatory process. On the other hand, it is not uncommon to find secondary inflammatory changes in any kind of carcinoma, particularly in the rapidly growing types of tumors, and one is not justified in concluding, therefore, that the inflammation was the cause of the tumor formation. This is particularly well illustrated in our case, where evidence of inflammation was noted only in the cancer-bearing tube and was entirely absent in the other uninvolved tube. Since inflammation of the fallopian tubes is very rarely a unilateral process, we hardly believe that the inflammatory changes found in the carcinomatous tube of our patient were primary, but in all probability these were secondary to the carcinomatous change. Inflammation of the fallopian tubes is comparatively a common occurrence, yet the development of carcinoma in such organs is unusually rare. This may be taken therefore as an argument to contradict the assumption that the tumor process is dependent upon previous inflammatory changes. It is quite possible, however, that the changes produced by the inflammatory process as a result of constant irritation, prepare the soil for the development of secondary neoplastic changes in an organ susceptible to the disease.

Another important phase of the question worth mentioning is the gross anatomic similarity of the tumor to that of inflammation, and unless the organ is very carefully examined both grossly and microscopically, such tumors may pass our attention and remain undiagnosed. A superficial inspection of the tumor recovered from our patient was hardly distinguishable from that of a thickened chronically inflamed tube. Microscopic examination of the tube, however, revealed the true nature of the disease.

#### SUMMARY

A case of primary carcinoma of the fallopian tube is presented. Some of the important phases of the disease are briefly discussed.

We are very much indebted to Dr. H. A. McCordock of the Department of Pathology of Washington University for taking the photomicrographs.

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## INTRACRANIAL HEMORRHAGE OF THE NEWBORN

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NO GREATER menace jeopardizes the life or the future well-being of the newborn child than intracranial hemorrhage, with its trail of suffering, idiocy, epilepsy, paralysis, and death. When we consider the forces and structures incident to our initiation into "light," the marvel is that they occur so infrequently. Various reports have made it as high as 50 per cent of the causes of death in the first few days. It may occur after a normal spontaneous delivery, breech or vertex, in long hard labors or in short precipitous deliveries, but is of greatest incidence in complicated cases requiring major obstetric procedures.

Cruveilhier<sup>1</sup> in his "Atlas" of 1832 illustrated intracranial hemorrhage of the newborn. Cushing,<sup>2</sup> in 1905, reported on cases treated surgically. But the real beginning of modern studies and opinions began in 1910 when Beneke<sup>3</sup> emphasized his method of postmortem examination by which the falx and tentorium are intact for inspection.

Various theories have been advanced for the explanation of the occurrence of the hemorrhage. Hemorrhagic diathesis, once considered a primary factor is now being put a little to one side as having been overemphasized. Holland<sup>4</sup> in his wonderful paper attributes it to the changes in the shape of the head in process of molding. The compression with the raising of the vault and septa causes tearing or obstruction with overdistention of veins. Seitz and Schwartz<sup>5</sup> have set forth the belief that the difference of intrauterine and extrauterine pressures causes the frequent cephalhematomas and also intracranial hemorrhage. Ehrenfest<sup>6</sup> explains it on a theory of parietal bones overriding. In a recent publication (*Cumulative Supplement and Composite Index to Gynecological and Obstetrical Monographs*, 1928\*) he reviews and discusses the various theories. He quotes Greenwood as showing by plaster casts of the skull of the immediate newborn, that there is an overlapping of the parietal bones in a normal vertex anterior delivery. And that lengthening is in the anterior posterior diameter and not in the vertical. In the after-coming-head deliveries, the vertical diameter is always increased. Ernest Sachs<sup>7</sup> in Abt's Pediatrics says, "the principal cause of this grave accident is the springing apart of the bones when the head is suddenly released from the compression of the birth canal, combined with the fact that the veins passing from the cortex of the sinus are for a short distance unsupported and therefore much more readily injured."

A visit to the postmortem table and the examination of the infant's skull, opened by the method of Beneke, will serve to impress on us the factors of the stress and strain placed on the falx and tentorium by the molding of the head during its passage through the birth canal. Molding of the head by pressure on the occiput, frontal, and parietal areas causes elongation toward the vertex and base, thus causing the falx to pull on the tentorium, often beyond its stretching point. This

\*Appleton & Co., New York.

causes a tear, involving smaller or larger vessels as the case may be. This method of examination has probably overstressed the findings of a torn falx or tentorium, and a study of the damage to the brain tissues has thus been neglected. More recently a modified Beneke method is being used, in which the brain tissue is hardened, fixed, and sectioned. Schwartz (*Ztschr. f.d. ges. Neurol. u. Psychiat.* 90: 263, 1924) is quoted as reporting hemorrhage or distinct areas of degeneration of the brain substance in 65 per cent of all infants up to five months.

#### SOURCE OF MATERIAL

The material for this study is based on the records of the Philadelphia Lying-In Hospital from October 1, 1927, to December 1, 1929. During this period there were 2256 deliveries. Of this group 78 babies were stillborn, giving a percentage of 3.46 per cent. The living births were 2178, with 81 deaths, or 3.71 per cent death rate.

Autopsy was secured on 53 of the 78 stillborn, with permission to open the head in 31 cases. In this group there were 11 cases of intracranial hemorrhage or an incidence of 35.4 per cent. Of the 81 deaths, 66 came to autopsy and the head was opened in 56 cases with intracranial hemorrhage present in 18 or 32.1 per cent.

After carefully checking all cases and discarding those of doubtful diagnosis, we found that there were 16 additional babies, with intracranial hemorrhage, who were discharged from the hospital either cured or greatly benefited by treatment. Then, of the 2256 deliveries we feel quite certain of making a diagnosis of intracranial hemorrhage in 45 or 1.9 per cent. Undoubtedly there were additional cases of hemorrhage, symptomless or having such indefinite or mild symptoms that they escaped our notice.

TABLE I. OCCURRENCE OF HEMORRHAGE IN 2256 DELIVERIES

	NO. OF CASES	% OF TOTAL	POST- MORTEMS	POST- MORTEM ON HEAD	WITH HEMORR.	% WITH HEMORR.
(a) Stillborn	78	3.46	53	31	11	35.4
(b) Deaths	81	3.71	66	56	18	32.1
(c) Hemorrhage with recovery	16	0.007			16	
(d) Total with hemorrhage	45	1.91				
(e) & (d) : 35.5% of cases with hemorrhage recovered.						

#### PREDISPOSING CAUSES

*Incidental Factors.*—According to Table II, a study of the incidental factors occurring in the 45 cases of intracranial hemorrhage, we find that the incidence of hemorrhage is slightly greater among the white than among the colored race. This is even more striking than the

figures indicate, since the majority of cases delivered were colored. It may possibly be accounted for by the fact that the average birth weight of our colored babies is about one pound less than that of the white babies, thereby causing less difficulty during delivery.

In this group there is very little difference in the occurrence of hemorrhage, whether the child be of a primiparous or a multiparous mother. The same applies as to whether the child was male or female.

The average age of the mother is twenty-four years, the youngest being sixteen years; the oldest thirty-seven years. In all of the 45 cases there was nothing particularly wrong in the prenatal health of the mother. There is no way of ascribing the cause to a deficient diet.

Quite a remarkable fact brought out is that 35 of these babies were full term, while only 10 were premature infants. In 4 cases there was a positive Wassermann.

TABLE II. FORTY-FIVE CASES OF INTRACRANIAL HEMORRHAGE

	STILLBORN	DEATHS	RECOVERIES	TOTALS
Colored	7	9	3	19
White	4	9	13	26
Primipara	7	7	9	23
Multipara	4	11	7	22
Male	5	8	9	22
Female	6	10	7	23
Age of mother	23	25	24	24
Prenatal health good	11	18	16	45
Gestation { Full term	8	11	16	35
} Premature	3	7	0	10
Positive Wassermann	2	2	0	4

## HOURS OF LABOR AND TYPE OF DELIVERIES

Referring to Table III we note that in 22 of the cases, the mother was in labor less than twelve hours, and in 21 the length was over twelve hours. In 2 cases the time was unknown. It is difficult at times to be certain of the length of the second stage of labor, but it is this stage which has a decided influence in the causation of intracranial hemorrhage. A precipitous delivery with a short hard labor is a dangerous thing for the infant. The injudicious use of pituitrin can be condemned, especially from the viewpoint of the infant.

It was noticed also, during the review of the records, that a large majority of the 45 cases developed after the mothers had been in the second stage of labor for two hours or more. It is our feeling that the obstetrician should use careful judgment in allowing any mother in the second stage of labor to continue over the two-hour period. Although 10 of the cases were delivered by forceps, which in this series had 2.3 per cent incidence of hemorrhage, and 14 by versions, which has an incidence of 7.6 per cent with hemorrhage, we feel that with few exceptions, a greater danger exists in permitting long labors than

in the skillful performing of some operative obstetric procedure. The 13.8 per cent occurrence of hemorrhage in the cases delivered by normal or spontaneous breech is very outstanding. The spontaneous vertex delivery, uncomplicated or with only minor complications has the lowest incidence, being 0.8 per cent in this series.

It is interesting to note that there was one case of intracranial hemorrhage in a baby delivered by cesarean section. This particular case occurred in a baby whose mother was in labor for thirty-eight hours without progress. There was no dilatation or effacement of the cervix. Contracted pelvis was also present. Cesarean section was performed. On delivery the child had to be resuscitated by carbon dioxide and oxygen. Progress was satisfactory for twenty-four hours, although the child did not nurse well. It then began to vomit blood and had respiratory difficulty. Forty c.c. of the mother's blood were given during the second day. The child died at the end of forty-eight hours from apparent respiratory failure. Postmortem examination showed hemorrhagic areas in the lungs, stomach, and intestines, also into the scalp with a marked subdural hemorrhage over the entire surface of the brain and into the lateral ventricles. No tears were found in the falx or tentorium. The bone marrow of the femur was blood red and of dry fatty consistency. Accordingly, we feel justified in making a diagnosis of hemorrhagic disease of the newborn with intracranial hemorrhage. In all probability the latter occurred during the long labor and was the cause of difficult resuscitation and early poor nursing.

TABLE III-A. LABORS AND DELIVERIES

	STILLBORN	DEATHS	RECOVERIES	TOTALS
Under 12 hours	7	10	5	22
12 to 24 hours	2	3	3	8
24 hours and more	2	5	6	13
Unknown				
Spontaneous	2	7	2	11
Forceps	3	2	5	10
Version	4	4	6	14
Breech	2	4	3	9
Cesarean	0	1	0	1

TABLE III-B. HEMORRHAGE ACCORDING TO DELIVERIES

	NO. OF CASES	NO. WITH HEMORR.	% WITH HEMORR.
Spontaneous	1482	11	0.8
Forceps	438	10	2.3
Version	183	14	7.6
Breech	65	9	13.8
Cesarean	88	1	1.1

In 18 of the cases, 14 of which died and 4 recovered (see Table IV), there was some difficulty with the primary respirations, making it necessary to use some form of resuscitation. Our delivery rooms are



equipped with a carbon dioxide-oxygen apparatus as recommended by Henderson,<sup>8</sup> and a modified Drinker respirator. As far as possible, all forms of artificial respiration of any other type have been abandoned. The matter of holding the baby vertically by the feet and slapping the trunk, or compressing the chest by manipulation of the infant's body, are questionable procedures, and may increase cerebral congestion or hemorrhage. Efforts at mouth to mouth insufflation, in certain cases may be sufficient to rupture air vesicles; or in other cases the air may be forced into the stomach. It would seem that the carefully regulated pressure of the carbon dioxide-oxygen apparatus is the method of choice, or the modified Drinker respirator.

#### SYMPTOMS

The symptoms as found in the 34 cases born alive, show that 94 per cent of the group were fretful; that is, they had a sharp, piercing, or at times a plaintive cry and did not sleep well. The fretfulness was increased by handling and particularly when the head was moved or when food was offered or other general care given. Six per cent were apathetic and made no sound of any kind. Seventy-six per cent nursed poorly, or not at all, and had difficulty in swallowing. The poor nursing consisted in lack of the sucking reflex when the nipple was placed in the baby's mouth. The difficult swallowing consisted in choking, regurgitation, and in some cases projectile vomiting when forced feeding was tried.

Intermittent cyanosis was present in 64 per cent. It has been observed that continuous cyanosis is more often associated with atelectasis and congenital heart disease or the less common cases of phrenic nerve paralysis. It is very unlikely that an intermittent cyanosis at this age would come from an enlarged thymus. The cyanotic spells may come on suddenly, provoked by disturbing the child for feeding. The best relief is secured by the administration of carbon dioxide and oxygen. During the acute stage, gentle artificial respiration may be carried on and respiratory stimulants, such as atropine or alpha-lobelin, given hypodermically. Prompt treatment is essential, as it is in one of these attacks that sudden death may occur. For this reason constant supervision must be maintained.

Muscular twitchings or convulsions were present in 58 per cent. The muscular twitchings are usually limited to the eyes and face, but may involve any or all extremities. Stern and Schwartz place great emphasis on the nystagmus of the first few hours of life and its relation to the amount of intracranial damage. Occasionally the muscular twitching develops into clonic convulsions with retraction of the head, arching of the back, and general spasticity. In such cases the prognosis is very poor. It does not seem possible to localize the hemorrhage by observation of these muscular twitchings. Also it would



seem that while the reflexes are generally increased, they, too, fail to give any localization.

From general observation of the cases which recovered we note an excessive loss of weight and that fever occurred in 85 per cent of these cases prior to the time of their lowest weight. This point we consider very significant in differentiating intracranial hemorrhage from dehydration fever. In the latter, the fever occurs at the point of lowest weight.

TABLE IV. WEIGHT—TEMPERATURE—SYMPTOMS

	STILLBORN	DEATHS	RECOVERIES	TOTAL
Birth weight				11
Under 6 pounds	4	7		
Over 6 pounds	7	11	16	34
Loss of weight				
Less than 8 ounces			5	5
8 to 16 ounces			9	9
16 ounces and more			2	2
Temperature				
Subnormal		2		2
Normal		8	4	12
Above normal		8	12	20
Symptoms				
Fretfulness		16	16	32 -94%
Poor nursing		13	13	26 -76%
Poor swallowing		14	12	26 -76%
Cyanosis (intermittent)		17	5	22 -64%
Muscular twitching		14	6	20 -58%
Primary respirations good		4	12	16
Primary respirations difficult		14	4	18
Apathetic		2	0	2

In arriving at a diagnosis of intracranial hemorrhage it must not be forgotten that a definite history of the hours of labor, type of delivery, and the primary respirations are important in conjunction with the symptoms presented.

From the diagnostic standpoint, lumbar or cisternal puncture findings furnish the most conclusive evidence of intracranial hemorrhage. Nevertheless, we feel that errors in diagnosis may be made by depending entirely on these findings. Errors in technic may easily occur whereby bloody fluid is secured. Pressure varies with the position of the child, its crying and struggling, and may lead to false conclusions. Our technic is as follows: A 20-gauge standard spinal puncture needle carrying a stylet is used. This is cut so as to be two and one-half inches long and have a sharp point with a short bevel.

For cisternal puncture the child is held horizontally on its right side, with its head supported and held in partial flexion by the left hand, and the legs and trunk controlled by the right hand of the assistant. The skin over the upper cervical and occipital area is prepared by painting with tincture of iodine, 3 per cent, and washing with alcohol. The needle is inserted into the pit formed by the edge of the foramen magnum and the spinous process of the atlas in the midline in a plane extending through this point, the external auditory canals, and the

glabella. The point of the needle thus often striking the edge of the occipital bone, when the butt of the needle is manipulated, is made to enter the foramen magnum. At the instant the resistance ceases, the point of the needle is in the cisterna magna. The needle has thus been inserted about three-fourths to one and one-half inches, depending upon the size of the child and the amount of subcutaneous tissue. The stylet is then removed and a pressure reading taken with a mercury manometer. When the pressure is high and the fluid is bloody, removal of from 5 to 10 c.c. of spinal fluid is permitted, or of whatever quantity is necessary to reduce the pressure to normal. Following the puncture, a gauze or cotton dressing is applied to the area, and the child is placed in the horizontal position in a warm bed.

Since cisternal puncture should be done only by an expert because of the possible dangers, for oft-repeated drainages or for diagnostic purposes on the child not acutely ill, we use lumbar puncture.

Following the suggestion of Glaser,<sup>9</sup> lumbar puncture is done with the child in vertical position. The assistant holds the child between the palms of the extended hands, the fifth fingers hooked under the knees, the thumbs over the shoulders and the other fingers supporting the sides of the child and holding it firmly to prevent lateral motion. The head of the child is supported by its lying forward against the wrists, thus giving firm support and stability to every part and not placing any strain on the child's body.

#### SPINAL FLUID FINDINGS

According to Table V, authentic spinal fluid pressures were recorded in 6 of the infants that died, 16 who recovered, and in 66 normal symptomless infants. The pressure findings showed an average of 15.7 mm. in the group which died, 11.5 mm. in the recovered, and 8 mm. in the normal cases. The fluid was yellow in 32 of the normal cases, all of which showed red blood corpuscles microscopically. Clear fluid was found in one infant that recovered. This same fluid had a negative benzidin test and there was no microscopic evidence of blood. It was under a normal pressure of 6 mm. However, muscular twitchings of the face and eyes were present, and the child nursed poorly, and now at five months of age shows retardation in its mental and physical development. However, some malformation of the brain may have existed to account for this. Clear fluid was also found in 20 of the normal cases, all but two showing red blood corpuscles microscopically.

TABLE V. SPINAL FLUID FINDINGS

	DEATHS	RECOVERIES	NORMAL
Number of cases	6	16	66
Average pressure	15.7	11.5	8
Type of fluid			
Bloody	6	15	14
Yellow	0	0	32
Clear	0	1	20

Probably the most important point to be learned from this spinal fluid study is the increase of pressure found in the cases of hemorrhage. It is more or less true that the greater the pressure, the larger and more serious the hemorrhage; also that hemorrhage cases almost invariably have bloody spinal fluid. But it is to be remembered that bloody fluid is found in normal symptomless infants which can probably be ascribed to unavoidable rupture of vessels while doing the puncture. Note, too, that a rare case of hemorrhage may have a clear spinal fluid.

The spinal fluid findings do not give any indication as to the location of the hemorrhage, which is an important factor in prognosis. Referring to Table VI, it is noted that of the 28 intracranial hemorrhage cases coming to autopsy 15, or 53.5 per cent, had hemorrhage at the basal area and an additional 4 cases had basal and cortical hemorrhage, making a total of 67.8 per cent with hemorrhage around the midbrain and its important vital centers. If one considers only the infants born alive, and dying with intracranial hemorrhage, such a hemorrhage was found at the base of the brain in 15 of the 17 cases or in 82.2 per cent. Some of these babies lived only a short time, 1 living five minutes, another twenty minutes, or according to Table VII, 10 babies lived less than twenty-four hours, 4 babies lived from twenty-four to forty-eight hours, 1 five days, 1 seven days, 1 nine days, and 1 fifteen days.

TABLE VI. HEMORRHAGE IN 28 CASES

	STILLBORN	DEATHS	TOTALS
Location			
Cortical	6	1	7
Basal	4	11	15
Combined	1	4	5
Intracerebral	1	1	2
Amount			
Large	7	11	18
Small	4	6	10

TABLE VII. DURATION OF LIFE IN 18 CASES

Less than 24 hours	10 cases
24 to 48 hours	4 cases
5 days	1 case
7 days	1 case
9 days	1 case
15 days	1 case

#### TREATMENT

As in all other afflictions of humanity, preventive treatment is the ideal, the golden fleece for which the medical profession of today is seeking. Such treatment must of necessity begin with the mother who should provide a healthy body to be the fountain of her offspring. In pregnancy she should have monthly examinations and proper super-

vision. A suitable diet with the necessary vitamins, as pointed out by Moore and Brodie,<sup>10</sup> is an important factor; also rest, exercise, and the other things contributing to the ideal prenatal health.

Better natal care with wise judgment in the use of pituitrin, forceps, version, section, and all the procedures of obstetric surgery is necessary; also proper intervention or nonintervention in labor; and better methods of handling and resuscitation of the newborn, using preferably the carbon dioxide and oxygen apparatus, or the Drinker respirator.

The transfusion of whole blood, we believe, is one of the greatest measures that has been advocated. Give 20 c.c. (ten in each buttock or interscapular area) of the mother's blood to the child before leaving the delivery room in cases of difficult labors and major obstetric procedures.

Careful nursing supervision and feeding are very important. Attempt to keep these infants as quiet as possible with the least amount of handling when changing is necessary. Feed by gavage when the difficulty of nursing and swallowing is noticeable. Give breast milk if it is at all available; otherwise, give skim lactic acid milk.

Bathing and dressing of the child will depend entirely upon the conditions. One or both may be omitted to provide for rest and quietness of the child.

Supportive treatment can always be given. Give minims III of spiritus frumenti in water with the feedings every three hours; atropine,  $\frac{1}{1000}$  gr., hypodermically, and Alpha-lobelin may be used as necessary. Provide for maintenance of body heat by a hot bed.

Do repeated drainage of the spinal fluid. This procedure may be contested by many authorities, but we believe that many lives may be prolonged and many infants live to become useful citizens because of this procedure.

#### SUMMARY

A study of 45 cases of cerebral hemorrhage is here presented. General incidence of hemorrhage among 2256 deliveries is 1.9 per cent. Of the stillborn babies that came to postmortem 32.1 per cent had hemorrhage. After discarding questionable cases, we find that 16, or 35.5 per cent, of the babies with hemorrhage have recovered.

The classical symptoms of hemorrhage were: A history of difficult delivery, difficult resuscitation, fretfulness, inability to nurse and swallow properly, intermittent cyanosis, muscular twitchings, excessive loss of weight, fever within the first two days, and increased intracranial pressure with bloody fluid.

Intracranial hemorrhage was found in infants delivered spontaneously, by forceps, versions, and breech extractions; in rapid precipitous deliveries and in prolonged and difficult labors.

We were unable in these cases to determine the size and location of the hemorrhage by clinical methods. Autopsy showed that a large proportion of the hemorrhages occurred in the basal areas.

In the fatal cases the infants nearly all died within forty-eight hours.

Drainage was done on 66 normal babies showing an average spinal fluid pressure of 8 mm. of mercury, bloody fluid in 14 cases, yellowish fluid in 32 cases, and clear fluid in 20 cases.

The treatment consisted of careful nursing and feeding, gavage when necessary, quiet and rest, stimulation, and repeated drainage for the relief of pressure symptoms.

#### CONCLUSIONS

1. Long second stage of labor, precipitous delivery, and difficult obstetric procedures are the chief causes of intracranial hemorrhage.
2. Prenatal health of the mother and hemorrhagic disease of the newborn do not seem to be important causative factors.
3. History of delivery, clinical symptoms, and lumbar or cisternal puncture are the essential points of diagnosis.
4. Repeated drainage of spinal fluid with relief of increased pressure is a most valuable means of treatment. Equally essential is good nursing and feeding care.
5. Preventive measures consist in skillful obstetric procedures, the use of carbon dioxide and oxygen for resuscitation, or the Drinker Respirator, and the transfusion of whole blood intramuscularly in all cases of possible hemorrhage.

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334 SOUTH TWENTY-FIRST STREET.

## MORTALITY IN HYSTERECTOMY OPERATIONS\*

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**H**YSTERECTOMY is one of the most generally performed of all operations. Its technic is well established. It is carried out daily by the gynecologist, the general surgeon, the occasional operator, and even the general practitioner. In properly selected cases it is one of God's greatest blessings; in improperly selected cases it may prove a curse by blasting the lives of the happily married, destroying all hope of progeny and producing a long period of morbidity which occasionally ends in insanity or suicide. If any reform is to be made regarding this popular operation it must originate with the gynecologist. The gynecologist should teach the profession and the laity the evil results of unsexing women in active sexual life, he should show by example the advantages of myomectomy over hysterectomy in certain cases.

Radium and x-ray should be substituted for hysterectomy in cases of hyperplasia, the so-called functional bleeding of the menopause and in many cases of fibroid tumors. The gynecologist should not only preach conservatism in inflammatory cases but should practice it.

The object of this paper is to show that hysterectomy has a mortality. One may occasionally run a series of 100 cases (usually selected) without a death but such statistics are of little value and sometimes harmful. It is only by reporting and making a careful study of the causes of death that a reduction in mortality and morbidity may be expected.

In reviewing a series of 200 consecutive hysterectomies at the Vanderbilt University Hospital, nine deaths were found to have occurred. All cases were included in which the cause of death was either immediate or remote. This gives a general mortality for the operations of 4.5 per cent. Table I shows the type of hysterectomy performed with the mortality for each group:

TABLE I

	NO.	MORTALITY PER CENT
Supravaginal hysterectomy	166	4.2
Complete abdominal hysterectomy	32	3.1
Chemical hysterectomies	2	50.0

\*Read before the Central Association of Obstetricians and Gynecologists at Excelsior Springs, Mo., October 10, 1930.



TABLE II. CAUSE OF DEATH IN NINE CASES

	NO.	PER CENT
Pulmonary embolus	3	1.5
Peritonitis	3	1.5
Shock and hemorrhage	2	1.0
Zinc chloride poisoning	1	0.5
Total	9	4.5

It is our purpose in this paper to discuss some of these causes of death in an attempt to reduce their incidence.

#### PULMONARY EMBOLISM

For this most unfortunate complication we are at a loss to offer any suggestions other than those commonly employed such as frequent changes of posture.

The state of the circulation is always a prime consideration with the surgeon. A few years ago all circulatory deaths were labeled as "heart failure." The war studies in regard to wound shock and the more recent studies at Vanderbilt University<sup>1</sup> have emphasized the great importance of peripheral circulatory failure as a cause of operative mortality.

The heart itself is rarely responsible for operative deaths provided the individual had a normal heart before operation. Even in patients with fairly advanced heart disease operative mortality is not extremely high. However, one must remember that postoperative pneumonia and embolism are much more common in patients with cardiac disease, and it is these complications rather than heart failure per se which should be of greatest concern. Proper preoperative treatment by rest, fluid restriction, digitalis, and diuresis when necessary, enable one to operate with a fair degree of safety on most patients with disease of the heart.

Another point to bear in mind in the question of cardiac failure as a complication of surgery is the question of age. The older the patient with cardiac disease the more likely is postoperative pneumonia to occur. A young individual with severe cardiac valvular disease is likely to withstand operation better than an elderly person with coronary arteriosclerosis. Patients with angina pectoris are, as a rule, very poor operative risks.

#### PERITONITIS AND BLOOD STREAM INFECTION

This complication occurred three times, two of the cases are directly attributable to intestinal injuries which resulted from freeing adhesions. In the third case the infection resulted from cutting across the cervix in a case where a presumably large myoma of the corpus was present. To our chagrin the bleeding came from a carcinoma which had not

been diagnosed and which extended into the cervix below the line of incision. The consequent soiling of the pelvis resulted in peritonitis.

Two of these cases came to autopsy and in both, cultures from the hearts blood were positive. In one case where a rent occurred in the sigmoid, drains were placed through stab wounds just above the crest of the ilia. The rent was carefully closed with two layers of interrupted intestinal catgut sutures. The sigmoid was dropped into the bottom of the pelvis and the omentum was spread over the pelvis. At autopsy the sutures in the intestine had sloughed out and the lumen was open for a short distance. In spite of this the infection was entirely localized to the pelvis and death was the result of blood stream infection. It would have been better if linen had been used instead of catgut. It is noteworthy in this series of cases that peritonitis only occurred when an infected viscus was opened.

Many of our cases were admitted to the hospital in a markedly anemic and septic condition, as a result of infected and degenerated myomas. We have come to rely on the sedimentation time as the best index of operability. The sedimentation time in these cases was forty-five minutes, thirty-three minutes, and sixteen minutes respectively. It should be borne in mind that the sedimentation time is a better index of tissue degeneration than of actual infection, but since tissue degeneration and infection usually go hand in hand it serves as a useful guide to infection. It is our present policy never to operate in the presence of a low sedimentation time but rather wait for it to rise.

#### SHOCK AND HEMORRHAGE

The similarity between the symptoms of shock and hemorrhage are too well known to require comment here. It has been clearly shown that in so-called traumatic shock the symptoms are really due to a loss of blood in the traumatized tissue itself. In hemorrhage the output of the heart is markedly diminished before the blood pressure begins to fall. The diminished volume of blood is compensated for by a decrease in the size of vascular bed as a result of vasoconstriction and in this condition a patient may have a very greatly impaired circulation with very slight changes in blood pressure. Our experience has led us to believe that in most cases of so-called surgical shock, hemorrhage is either the chief or a contributory factor. There are undoubtedly cases of shock in which hemorrhage is not a factor. This type of shock has been produced experimentally as a result of bullet wounds in the axilla.<sup>2</sup> In this type of shock, vasodilatation is the rule in contradistinction to vasoconstriction in the hemorrhagic type. We feel, however, that the bloodless type of shock which has been designated as neurogenic is comparatively rare and it is our firm belief that the avoidance of blood loss would eliminate shock as a factor in pelvic surgery. One of our patients was operated upon under spinal anes-

thetia. In this case we were faced with the unusual condition of a double uterus with fibroids in each horn. A mild hemorrhage occurred from the endometrium. The patient went into profound shock shortly after being returned to the ward, and died. We were unable to explain this death and did not know whether to attribute it to the spinal anesthetic or not. The clinical fact that a patient under spinal anesthesia suffered a mild hemorrhage with fatal results could not be overlooked.

Animal investigations were undertaken on spinal anesthesia and it was shown that the fall in blood pressure is the direct result of vasodilatation.<sup>3</sup> The cardiac output decreases<sup>4</sup> after the pressure falls and for this reason the low pressure of spinal anesthesia is better tolerated than a low pressure from hemorrhage. A patient with a blood pressure of 80 mm. under spinal anesthesia may have a larger cardiac output than one suffering from hemorrhage who has a normal pressure. In spinal anesthesia a good portion of the vasomotor system of the entire body is paralyzed and when we consider that the compensatory mechanism of the body in hemorrhage is vasoconstriction, it is apparent that when spinal anesthesia is administered this compensatory mechanism for hemorrhage is also paralyzed.

Experiments show that normal dogs can stand<sup>5</sup> a blood loss of from 3 to 5 per cent of their body weight, but when spinal anesthesia is administered losses of only 1 per cent are serious and may be fatal. Consequently, we feel that the explanation for the case given above is at hand. The use of ephedrine clinically or experimentally has never completely obviated this danger, although it is the most powerful stimulant that we have. The value of transfusion in cases of lowered blood pressure from hemorrhage, neurogenic shock or spinal anesthesia cannot be overestimated. In these conditions it is almost specific.

#### ZINC CHLORIDE POISONING

In view of the recent appearance of several articles on chemical hysterectomy and the use of zinc chloride, by Masson,<sup>6</sup> Mayo,<sup>7</sup> Babcock<sup>8</sup> and others, one of our cases is of unusual interest. The patient aged thirty-five, bleeding as a result of hyperplasia of the endometrium was curetted under spinal anesthesia, the uterus was packed with gauze saturated with 50 per cent zinc chloride. Immediately the patient showed evidence of respiratory distress and shortly died. Upon testing the toxicity of zinc chloride it was found that a dosage of 7.8 mg. per kilo was lethal for dogs. It was obvious in this case that zinc chloride is extremely toxic and is entirely too dangerous to be used in the uterus. Babcock cited numerous cases in the German literature of the use of zinc chloride resulting fatally. We mention this method only to condemn it.

## CONCLUSIONS

1. A series of 200 hysterectomies of various types performed for a variety of pathologic conditions is reported with the mortality of 4.5 per cent. The value of the sedimentation time is stressed.
2. The value of transfusion as a preventive for shock rather than as a therapeutic measure for shock is advocated.
3. The danger from hemorrhage under spinal anesthesia has been shown.
4. Zinc chloride as an agent for chemical hysterectomy is condemned.

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## OBSTETRIC MORTALITY

## AN ANALYSIS OF 2268 MATERNITY CASES AT THE BRONX HOSPITAL\*

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IN VIEW of the latest report on obstetric mortality in New York City, which emphasizes the high rate as compared with other cities of this and European countries, a determined effort has been made on the part of the several medical societies of New York City to ascertain the facts and conditions leading to this high death rate. The purpose is to correct the causes at their origin, or at least, to bring before the attention of the medical profession those elements which contribute directly or indirectly to the ill effects on mother and child.

This paper, in an attempt to bring out the details leading up to such maternal and fetal deaths, is presented in the hope that by means of such figures and data as have been gathered over a period of three and one-half years from 2268 consecutive cases on the Obstetric Service of the Bronx Hospital, some further light may be shed upon the relation between the obstetrician's handling of the case in accordance with the best teaching of today and the ultimate result.

As a preliminary it is necessary to define certain terms and conditions referred to in this paper:

1. The Obstetric Service of the Bronx Hospital admits patients pregnant five months or more. The "lying-in" period averages ten days postpartum.

\*Read at a meeting of the Clinical Society of the Bronx Hospital.

2. The Prenatal Department admits patients at any time after a positive diagnosis of pregnancy has been made.

3. The Ward Service and Prenatal Clinic are directly under the supervision of the Obstetric Staff, but the "courtesy" or private service is not subject to the same strict surveillance, although it is necessary for the latter to observe the same rules for asepsis and medical care as the former.

4. A stillbirth is a fetus in whom there has been no respiratory effort on the part of the child, whether or not there has been any heartbeat before or after delivery.

5. A neonatal death is one that occurs any time after the first respiratory gasp and within the ten-day "lying-in" period in the hospital.

6. A premature baby is one that was less than nine lunar months in utero, or, where the time factor was not available, that weighs less than 1600 grams ( $3\frac{1}{2}$  pounds). This figure is chosen arbitrarily as the one closest to the period of viability.

During the years of 1927, 1928, 1929, and the first six months of 1930, there were delivered at the Bronx Hospital, 2268 mothers and 2290 babies. During this period there were 6 maternal deaths, 52 stillbirths, and 30 neonatal deaths.

Considering the maternal cases first, there were 6 deaths out of 2268 total consecutive confinements, a mortality rate of 0.27 per cent; i.e., 2.7 per thousand, or 1 in 377 cases. The histories of two of these patients who died are briefly as follows:

1. A case of uterus didelphys in which there appeared symptoms of acute inflammation of abdominal viscera. The patient was operated upon and found to have a necrotic right ovary and diffuse *Streptococcus hemolyticus* peritonitis from which she died three days later. Within twenty-four hours postoperative a premature stillbirth was delivered spontaneously.

2. A case of acute intestinal obstruction with possible neoplasm, complicating a pregnancy in a cardiopath. Surgical consultation advised against laparotomy. Labor was induced by means of a Voorhees bag, and the baby delivered with medium forceps; but the patient died suddenly four hours later of cardiac decompensation.

In an attempt to arrive at a figure directly attributable to institutional care and Obstetric Staff responsibility, it has been deemed advisable to subtract these two cases from the total of six maternal deaths, thus leaving a corrected percentage of 0.18 per cent; i.e., 1.8 per thousand, or 1 in 566 cases. In this connection the figures for the New York City Health Department for the entire city show for the

TABLE I. MATERNAL DEATHS

	YEAR	NUMBER OF CASES	NUMBER OF DEATHS	PER CENT RATE	PER THOU- SAND
New York City	1929	124,404	629	0.50	5.0
Nursery and Child's Hospital	1929	2,180	6	0.27	2.7
Woman's Hospital	1928-9	2,713	26	0.95	9.5
Lying-In Hospital	1929	4,653	21	0.45	4.5
Bronx Hospital	1927-8-9	2,268	6	0.27	2.7



corresponding period of time a maternal death rate of 0.52 per cent in 379,625 births.

Table I shows a comparison of figures of maternal deaths in several hospitals of New York City.

In the four remaining maternal deaths there were:

- One cesarean section
- One internal podalic version and extraction
- One forceps delivery
- One spontaneous delivery

A consideration of the operative cases follows:

There were performed 23 cesarean sections in 2,268 cases delivered, an incidence of 1.0 per cent, or 1 in 98 cases, with a maternal mortality rate of 4.3 per cent for this operation. Death in this case was due to eclampsia with hypertension, cerebral hemorrhage, and coma. The operation per se was not in any way responsible for the fatal outcome, since the patient at the time of the cesarean section was unconscious and moribund.

Internal podalic version and extraction were resorted to in 25 of the 2,268 deliveries; i.e., 1.1 per cent, or 1 in 90 cases, with a maternal mortality rate of 4.0 per cent for this maneuver. Death here occurred in a patient admitted to the hospital as an emergency case because of prolonged labor and exhaustion. To correct a persistent occipito-posterior position, the Kielland forceps were applied but without success. This was followed by an internal podalic version and the baby extracted. The mother, however, died within twenty-four hours with symptoms of acute cardiac failure.

Forceps deliveries were accomplished 137 times in 2,268 confinements, an incidence of 6.04 per cent, or 1 in 16 cases, with a maternal mortality of 0.67 per cent for this operative procedure. This included high forceps, midforceps A and B, Kielland and Scanzoni maneuvers, and low forceps. Death occurred in a case of persistent occipito-posterior position in which Kielland medium forceps were employed to hasten the second stage of labor. Following delivery, symptoms of concealed hemorrhage appeared, and the patient died on the third day postpartum.

In the remaining patient who was delivered spontaneously of triplets, death was due to postpartum sepsis following the retention of secundines with subsequent infection.

In considering the death of the babies, there are the following items of interest. There were born 2,290 babies to these 2,268 mothers, including 20 sets of twins and 1 set of triplets. Of these there occurred:

Stillbirths	52, or 2.2%, or 22 per thousand
Neonatal deaths	30, or 1.3%, or 13 per thousand



a total death rate of 82 in 2,290 births; i.e., 3.5 per cent, or 1 in 28. The Department of Health (1929) figures show a fetal death rate of 7.6 per cent. This, however, includes embryos in all periods of gestation. Table II shows a comparison of fetal death rate of various hospitals in New York City:

TABLE II. FETAL AND NEONATAL DEATHS

	YEAR	NUMBER OF CASES	NUMBER OF DEATHS	PER CENT RATE	PER THOU- SAND
New York City	1929	124,404	9,496	7.6	76
Nursery and Child's Hospital	1929	2,174	110	5.0	50
Woman's Hospital	1928-9	2,748	175	6.3	63
Lying-In Hospital	1927	5,508	379	6.8	68
Bronx Hospital	1927-8-9	2,290	82	3.5	35

Bearing in mind the definition previously given of a stillbirth, as a baby in whom no respiratory effort has been made at any time, these cases are further classified as follows in Table III.

TABLE III. STILLBIRTHS

	NUMBER OF CASES	PER CENT OF TOTAL BIRTHS
Premature (1600 gm. or less)	10	0.39
Full-term, operative	22	0.96
Full-term, spontaneous	20	0.87
Total	52	2.27

In the consideration of neonatal deaths all cases are included in which the baby breathed even once and in which death occurred either immediately thereafter or within the first ten days of the puerperium at the hospital. These are classified in Table IV as follows:

TABLE IV. NEONATAL DEATHS

	NUMBER OF CASES	PER CENT OF TOTAL BIRTHS
Premature (1600 gm. or less)	15	0.69
Full-term, operative	5	0.21
Full-term, spontaneous	10	0.42
Total	30	1.32

Also it is of interest to consider the type of delivery in conjunction with the death of the full-term baby. This is detailed in Table V:

TABLE V. FULL-TERM FETAL MORTALITY

	STILLBIRTHS	NEONATAL
Operative delivery	22	5
Spontaneous delivery	20	10
Total	42	15 = 57

We see here that of the full-term babies, the number of stillbirth and neonatal deaths total 57 out of 2,290 births. Also, that the fetal deaths occurring in spontaneous deliveries outnumbered those in operative deliveries, 30 to 27.

Next in order is a consideration of the important causes of death in these 82 babies, of which 57 were of full-term gestation and 25 were premature. This is shown in detail in Table VI.

TABLE VI. CAUSE OF DEATH

	FULL-TERM		PREMATURE	TOTAL
	STILLBIRTH	NEONATAL		
Asphyxia and atelectasis	36	4	23	63
Cerebral hemorrhage	1	8		9
Anomalies and malformations	4	3	2	9
Fractured vertebra	1			1
Total	42	15	25	82

It is seen thus that asphyxia and atelectasis accounted for the greatest number of deaths, 63, most of which occurred in utero. The diagnoses of these deaths were based on clinical, x-ray, and autopsy findings. The 9 cases of congenital anomalies, all of which occurred in the fetal deaths noted above, are detailed in Table VII.

TABLE VII. CONGENITAL MALFORMATIONS AND ANOMALIES

	STILLBIRTH	NEONATAL
Diaphragmatic hernia		2
Patent foramen ovale		2
Hydrocephalus	1	
Polycystic kidney	1	
Cleft palate and harelip	1	
Anencephalus		1
Spina bifida	1	

Possibly of greatest importance in the study of cause and effect are Tables VIII and IX in which are set down the more common causes and conditions occurring in obstetric practice, and the methods employed to deliver the baby in these cases.

TABLE VIII. ABNORMAL CONDITIONS DURING LABOR

	FULL-TERM		PREMATURE	TOTAL
	STILLBIRTHS	NEONATAL		
Maternal toxemia	9		2	11
Prolapsed cord	8			8
Placenta previa	1	1	2	4
Persistent posterior position	6			6
Maternal cardiac decompensation			2	2

Of these the greatest incidence of fetal mortality occurred with maternal toxemia as a cause eleven times, while prolapsed cord accounted for eight deaths. The operative procedures employed in the delivery of the baby are detailed in Table IX.

TABLE IX. OPERATIVE PROCEDURES

	MOTHER			BABY				
	TOTAL	MATERNAL DEATHS	PER CENT RATE	FULL-TERM		PREMATURE		PER CENT RATE
				STILL-BIRTH	NEO-NATAL	STILL-BIRTH	NEO-NATAL	
Forceps	137							
High	2			1				50
Mid	29			4			1	16
Low	83			1				1.1
Scanzoni	3			1				33
Kielland	20	1	5.0	1				5
Cesarean section	23	1	4.3	2	1	1		17
Internal podalic version and extraction	25	1	4.0	10	3	1	1	60
Breech presentation and extraction	38			4		1	1	15
Total	223	3	1.3	24	4	3	3	14

It must be noted here that 2 cases have been omitted from this table, the two maternal deaths not considered as purely obstetric fatalities. These have been discussed in the early part of this paper.

It is interesting to observe that of the 2,268 deliveries, 233 were operative procedures; yet there were only 3 maternal deaths (corrected), or 1.3 per cent, and 34 fetal and neonatal deaths, or 14.5 per cent. Among the spontaneous deliveries, which numbered 2,035 cases, there was but 1 maternal death, or 0.04 per cent; while there were 48 fetal and neonatal deaths, or 2.3 per cent.

At the Bronx Hospital, the Kielland forceps were usually applied in cases of persistent occipitoposterior position in preference to the Scanzoni or Pomeroy maneuvers. In 22 attempts at Kielland maneuver, internal podalic version was subsequently employed twice. Among the remaining 20 successful attempts, there was one maternal death (the concealed hemorrhage), and one fetal death.

In reviewing the foregoing facts and figures, one is struck by the various causes of maternal and fetal death, and the numerous operative procedures. The question naturally arises, have the greatest care and maximum precautions been taken to insure the best results for the patient? Is it possible to reduce the death rate still further? According to Polak, "maternal mortality is made up of infections, toxemias, hemorrhages, obstetric accidents, and operative deaths, all to some extent preventable."

It is conceded that prenatal care is of utmost value in the reduction of obstetric morbidity. However, it is inevitable that even in clinics in which prenatal care is strongly emphasized, a certain number of patients will be lost. There will always be some deaths due to embolism and cardiac failure. Cerebral hemorrhages and paralyzes occasionally occur, as well as acute abdominal infections, with a high mortality rate. Eclampsia may occur even in the most carefully watched case in which all precautions have been taken, though the

incidence has been markedly diminished in the last few years. The "human factor" is always present, more so in the class of people that goes to make up ward cases, and the strictest warnings and sincerest advice often fall upon deaf ears and ignorant minds, rendering valueless all the scientific precautions and skillful obstetric procedures.

This, in a measure, is also true of fetal mortality which depends upon several factors.

1. Placental disease caused by intercurrent infections, toxemias, and lues. These explain the majority of prematures, macerated babies and congenital anomalies and malformations.

2. Malposition and disproportion causing dystocia and increasing fetal distress.

3. Character of labor and type of operative delivery causing cerebral hemorrhage, asphyxia, fractures, palsies, etc.

Owing to strict supervision of obstetric cases, during the antepartum period as well as during the hospital stay, the number of fetal deaths would seem to have been materially reduced here as compared with published figures of other institutions and of New York City generally. However, this paper is not intended as a comparative study of the several hospitals mentioned in the tables, since the conditions governing the admission of patients vary, as well as the social status of the patients themselves.

#### SUMMARY

The figures quoted above and the tables outlined, indicate a maternal mortality per 1000 of 2.7, a stillbirth rate of 22, and a neonatal death rate of 13. The number of maternal and fetal deaths has reached a low figure at the Bronx Hospital. This has been brought about, first, by concentration of care upon the mother in the last three months of pregnancy; second, by a general attitude of conservatism during labor, with interference only when delay and procrastination might possibly result in morbidity or death.

We wish to express our deep appreciation to Drs. Meyer Rosensohn and Hyman J. Epstein, the attending obstetricians at the Bronx Hospital, for the privilege of reporting this material and for their aid in making this study.

# THE ORAL ADMINISTRATION OF SODIUM ISO-AMYLETHYL BARBITURATE (SODIUM AMYTAL) IN LABOR

## A PRELIMINARY REPORT\*

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**A**MYTAL (iso-amylethyl barbituric acid) was synthesized in 1923<sup>1</sup> and was described as the most active hypnotic of the dialkyl derivatives of barbituric acid.

Details for the preparation of sodium amytal (sodium iso-amylethyl barbiturate) were described in 1926.<sup>2</sup> During the past seven years amytal or sodium amytal has been used by a number of experimenters with animals.<sup>3, 4, 5, 6, 7, 8, 9, 10, 11, 12</sup> Zerkas and his coworkers<sup>13</sup> first described, in 1929, the use of sodium amytal intravenously to produce anesthesia in the human being. Since that time, it has been administered clinically by the following routes: intravenously,<sup>15, 16, 18, 19, 20, 21</sup> intramuscularly,<sup>22</sup> rectally,<sup>14</sup> and orally.<sup>15, 16, 17, 23</sup> Its advantages in surgery as an anesthetic and for preanesthetic preparation have been described.<sup>13, 15, 16, 17, 18, 24, 25, 26</sup> Its ability rapidly to control the convulsions of eclampsia,<sup>18, 22, 27</sup> of tetanus,<sup>18, 20</sup> and of cocaine and of novocaine poisoning,<sup>20</sup> has been established. A number of writers<sup>14, 18, 20, 22, 28</sup> has described its use in obstetrics; the method of administration in these cases has almost uniformly been intravenously.

As there has been no description of the oral administration of this drug in labor, this work was undertaken to evaluate its effectiveness and to determine the proper system of dosage.

**Dosage.**—This has proved quite difficult. The lethal dose for man is not known, and no direct application can be made of fatal doses established for certain animals.<sup>29, 30, 32</sup> The upper margin of a safe dose intravenously has been placed at twenty-five grains<sup>31</sup> and we have not exceeded this, but our total dosage during labor has in several instances reached thirty grains.

**Administration.**—We have administered sodium amytal orally so far to fifty patients. No attempt was made to select the patients. All the patients were hospital cases. As soon as the patient was in definite labor with regular pains and beginning dilatation of the cervix, the administration was begun.

Our patients fall into two groups. There were seventeen who received as the initial dose nine grains. As labor progressed a number received an additional six grains after about two hours; and a few of this number received an additional six grains in the latter part of the first stage.

The patients in the second group received as the initial dose fifteen or eighteen grains. The majority received the latter dose. One or

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two additional doses of six grains were given as labor progressed in the majority of these cases. The results in this group have been tabulated under two heads: primiparae and multiparae. There were fourteen primiparae and nineteen multiparae in this group.

We were interested in this series to note the rapidity of action of sodium amytal orally, the efficiency of it in giving the patient relief from the pains throughout labor, the possible value of it in long and short labors, and finally, variations in susceptibility or idiosyncrasies which might prevent any routine scheme of administration being carried out. Our standard for efficiency was the production of a complete amnesia from the time the drug was administered.

No additional medication was given. It may be advisable in certain cases to combine the action of sodium amytal with that of morphine and magnesium sulphate, but we were anxious for our results to denote the single action of one drug. During labor we did everything to favor rest and sleep. All external stimulation was reduced as much as possible, examinations were reduced to a minimum, and the patient was allowed as much freedom as possible from disturbance.

The indication for additional administration after the initial dose was increasing severity of the pains with evidence of the labor lasting several hours longer and the observation that the maximum effect of the drug had been obtained. The additional doses were not given until approximately two hours after the initial dose.

*Action.*—An excellent result from the administration of sodium amytal orally was obtained only in patients in labor who received an initial dose of fifteen grains or more. In these patients the following effects were noted. Action of the drug was on the average noted in twenty-seven minutes, when the patient became very drowsy and slept between pains. The severity of labor at the time of administration was apparently a definite factor in the rapidity of action. Difficulty was encountered in measuring the time of the maximum effect, because of the fact that the increasing severity of the pains often masked the increasing action of the drug. At this time the patient usually slept between pains, but became aroused during the pain, squirming, often complaining of the pain, tossing about in bed, and in some cases assuming the crouching position. Immediately after the pain was over, the patient dropped back into sound sleep. This effect in the average cases was reached within forty-five minutes. When restlessness or alertness between pains and undue complaint of pains were noted, an additional dose was given. The general condition of the patient during this time was excellent. Skin was flushed and warm. No cyanosis was noticed. All reflexes were present. The patient could always be aroused by external stimuli, but often answered questions unintelligently and followed instructions poorly. There were no noticeable changes in pulse and temperature. In normal cases there was ob-



served only a moderate fall in blood pressure which in the majority of cases did not exceed 10 mm. No evidence of gastrointestinal upset from the oral administration was noted. Patients took their fluids well and elimination was good.

*Labor.*—We have not noticed any prolongation of labor from the use of sodium amytal. The average duration of labor has been: primiparae, first stage  $13\frac{1}{2}$  hours, second stage 41 minutes; multiparae, first stage  $4\frac{1}{2}$  hours, second stage 16 minutes. The efficiency of the pains has apparently not been decreased; in a few cases an apparent increase was noted. Restlessness and excitement have been the most untoward features of its use. Constant nursing supervision is necessary for this reason. A few patients have become very excitable and required restraint.

In the second stage it is impossible to get these patients to cooperate in "bearing down"; however, involuntary expulsive action occurs with good result and our series show no increase in the length of the second stage. A factor in the shortness of our second stage is, no doubt, due to our practice of performing episiotomies early and almost routinely in primiparae and of not hesitating to use perineal forceps frequently.

*Delivery.*—The restlessness of the patient is often most annoying at this time, when she may thrash about considerably and disarrange the drapes and otherwise interfere with the smoothness of the delivery. This cannot be controlled by the administration of nitrous oxide, for we have found that even small amounts of this caused the

TABLE I. CASES IN WHICH THE INITIAL DOSE WAS 9 GRAINS

CASE NUMBER	AGE	PARITY	P.P.	FIRST STAGE	SECOND STAGE	TERMINATION OF LABOR	TOTAL DOSAGE GRAINS	RESULTS
83812	24	i	O.D.A.	7 <sup>h</sup> 0 <sup>m</sup>	0 <sup>h</sup> 50 <sup>m</sup>	Spontaneous	27	Excellent (a)
84969	23	i	O.L.A.	11 <sup>h</sup> 40 <sup>m</sup>	1 <sup>h</sup> 25 <sup>m</sup>	Low forceps	9	Sedation
84717	22	i	O.L.A.	6 <sup>h</sup> 40 <sup>m</sup>	0 <sup>h</sup> 47 <sup>m</sup>	Episiotomy, low forceps	21	Sedation
84915	18	i	O.D.A.	11 <sup>h</sup> 25 <sup>m</sup>	0 <sup>h</sup> 30 <sup>m</sup>	Episiotomy, spontaneous	9	Sedation
84609	21	i	O.L.A.	1 <sup>h</sup> 20 <sup>m</sup>	0 <sup>h</sup> 30 <sup>m</sup>	Spontaneous	9	Sedation
84652	23	ii	O.L.A.	7 <sup>h</sup> 15 <sup>m</sup>	0 <sup>h</sup> 15 <sup>m</sup>	Spontaneous	9	Sedation
85610	37	v	O.L.A.	2 <sup>h</sup> 0 <sup>m</sup>	0 <sup>h</sup> 4 <sup>m</sup>	Spontaneous	9	Sedation
84879	28	iv	O.L.A.	4 <sup>h</sup> 30 <sup>m</sup>	0 <sup>h</sup> 20 <sup>m</sup>	Spontaneous	21	Fair
84875	18	ii	O.L.A.	1 <sup>h</sup> 55 <sup>m</sup>	0 <sup>h</sup> 20 <sup>m</sup>	Spontaneous	9	Sedation
80818	37	v	O.L.A.	2 <sup>h</sup> 0 <sup>m</sup>	0 <sup>h</sup> 4 <sup>m</sup>	Spontaneous	9	Sedation
84612	28	vii	O.L.A.	0 <sup>h</sup> 35 <sup>m</sup>	0 <sup>h</sup> 4 <sup>m</sup>	Spontaneous	9	No effect
82078	35	iii	O.L.A.	4 <sup>h</sup> 0 <sup>m</sup>	0 <sup>h</sup> 20 <sup>m</sup>	Spontaneous	9	Sedation
84764	18	ii	O.L.A.	4 <sup>h</sup> 0 <sup>m</sup>	0 <sup>h</sup> 35 <sup>m</sup>	Spontaneous	15	Fair
84887	22	ii	S.D.A.	0 <sup>h</sup> 50 <sup>m</sup>	0 <sup>h</sup> 20 <sup>m</sup>	Spontaneous	9	No effect
84881	25	iii	O.D.A.	2 <sup>h</sup> 40 <sup>m</sup>	0 <sup>h</sup> 15 <sup>m</sup>	Spontaneous	15	Good
84623	29	ii	O.L.A.	7 <sup>h</sup> 0 <sup>m</sup>	0 <sup>h</sup> 35 <sup>m</sup>	Spontaneous	9	Fair
83868	38	ix	O.L.A.	14 <sup>h</sup> 25 <sup>m</sup>	0 <sup>h</sup> 32 <sup>m</sup>	Low forceps	21	Fair

(a) Patient received 15 grains (initial dose 9 grains and 6 grains later) preparatory to insertion of Voorhees bag.

TABLE II. CASES IN WHICH THE INITIAL DOSE WAS 15 GRAINS OR MORE (PRIMPABAE)

CASE NUMBER	AGE	PARITY	COMPLICATIONS OF PREGNANCY	P.P.	FIRST STAGE	SECOND STAGE	TERMINATION OF LABOR	TOTAL DOSAGE GRAINS	SUPPLEMENTAL ANESTHETIC	RESULTS
85002	20	i	0	O.D.P.	16 <sup>h</sup> 0 <sup>m</sup>	0 <sup>b</sup> 25 <sup>m</sup>	Spontaneous	27	250 gallons nitrous oxide	Excellent
85092	24	i	0	O.L.A.	15 <sup>h</sup> 45 <sup>m</sup>	0 <sup>b</sup> 57 <sup>m</sup>	Episiotomy, spontaneous	21	30 gallons nitrous oxide	Excellent
85152	17	i	0	S.D.A.	27 <sup>h</sup> 20 <sup>m</sup>	0 <sup>b</sup> 10 <sup>m</sup>	Breech extraction. Third degree laceration	21	100 gallons nitrous oxide	Excellent
85188	19	i	0	O.L.A.	5 <sup>h</sup> 30 <sup>m</sup>	1 <sup>b</sup> 0 <sup>m</sup>	Episiotomy, spontaneous	24	80 gallons nitrous oxide	Excellent
85327	20	i	0	O.L.A.	13 <sup>h</sup> 35 <sup>m</sup>	0 <sup>b</sup> 20 <sup>m</sup>	Midforceps, episiotomy	24	100 gallons nitrous oxide	Excellent
85238	28	i	0	O.L.A.	8 <sup>h</sup> 30 <sup>m</sup>	0 <sup>b</sup> 15 <sup>m</sup>	Episiotomy, low forceps	24	100 gallons nitrous oxide	Excellent
85094	17	i	0	O.L.A.	18 <sup>h</sup> 35 <sup>m</sup>	1 <sup>b</sup> 31 <sup>m</sup>	Episiotomy, spontaneous	30	35 gallons nitrous oxide	Excellent
85509	20	i	Preeclamptic toxemia	O.D.A.	10 <sup>h</sup> 35 <sup>m</sup>	0 <sup>b</sup> 20 <sup>m</sup>	Spontaneous	18	50 gallons nitrous oxide	Excellent
85534	16	i	0	O.L.A.	29 <sup>h</sup> 0 <sup>m</sup>	0 <sup>b</sup> 35 <sup>m</sup>	Episiotomy, spontaneous	18	75 gallons nitrous oxide	Excellent
85505	26	i	0	O.L.A.	(b) 7 <sup>h</sup> 5 <sup>m</sup>	0 <sup>b</sup> 27 <sup>m</sup>	Episiotomy, spontaneous	30	No	Excellent
85638	16	i	0	O.L.A.	3 <sup>h</sup> 30 <sup>m</sup>	0 <sup>b</sup> 25 <sup>m</sup>	Spontaneous	18	100 gallons nitrous oxide	Excellent
85698	20	i	Preeclamptic toxemia	O.D.P.	2 <sup>h</sup> 30 <sup>m</sup>	1 <sup>b</sup> 45 <sup>m</sup>	Manual rotation. Low forceps	18	135 gallons nitrous oxide	Excellent
85008	39	i	0	O.D.P.	4 <sup>h</sup> 0 <sup>m</sup>	1 <sup>b</sup> 13 <sup>m</sup>	Spontaneous	15	112 gallons nitrous oxide	No results (a)
84800	24	i	Preeclamptic toxemia	O.L.A.	2 <sup>h</sup> 50 <sup>m</sup>	0 <sup>b</sup> 55 <sup>m</sup>	Episiotomy, spontaneous	15	75 gallons nitrous oxide	No results (a)

(a) Drug not given until patient was far advanced in labor.

(b) Drug not given until four hours before delivery.

pains to cease. We have therefore confined our supplemental inhalation anesthetic to the time of actual delivery and for the repair of lacerations and episiotomies.

The amount of anesthesia necessary has been greatly reduced. A smaller quantity of nitrous oxide and a higher concentration of oxygen have been the rule. This is taken smoothly by the patient. There is no cyanosis, vomiting, or postanesthetic discomfort. Ether has not been necessary. We do not know whether sufficient relaxation for a combined podalic version can be obtained from sodium amytal and nitrous oxide and oxygen. We have not had occasion to do one in this series.

There has been no increase in operative deliveries in our series. There have been 9 operative deliveries in these 50 cases; low and perineal forceps, 7; midforceps, 1; and 1 case in which cervical dilatation was completed with a Voorhees bag. In none of these cases did poor pains or prolongation form an indication. The low forceps extractions were done either in association with episiotomies out of respect for the pelvic floor or because of signs of fetal embarrassment. The midforceps delivery was done because of slight irregularity of the fetal heart.

*Postpartum.*—There have been no complications of the immediate or remote puerperium noticed. The uterus contracted firmly after delivery. There has been no postpartum hemorrhage. There have been observed no shock, chills, or marked changes in blood pressure, temperature, or respiration. The patient, as a rule, drops off into a quiet, restful sleep. The duration of sleep usually averages eight hours; she is usually drowsy for another four hours, after which she awakes quite alert, with no recollection of the entire labor, after the first administration of the drug. None of the following symptoms has been noticed: pulmonary edema, pneumonia, rash, itching, nausea, gastrointestinal upsets, headache, or gaseous distention. Elimination has been good. There has been no increased use of the catheter observed. Until the patient has reacted, there is need for constant nursing supervision.

*Babies.*—Babies at time of delivery are quite lively and cry readily. There has been no evidence of cyanosis or narcosis. Several of the babies delivered by forceps required a slight amount of resuscitation. Only one baby in the entire series died. Death occurred on the fifth day from hemorrhagic disease of the newborn. A study of the nursery records of these babies shows nothing abnormal in their nursery progress.

*Results.*—The results of our experience in the oral administration of sodium amytal to 50 unselected patients in labor are tabulated in three tables. Our results have been expressed as follows: *No effect*; *sedation*, where a slight drowsiness was noticed, but no analgesia or amnesia obtained; *fair*, where there was some slight analgesia and we felt as

TABLE III. CASES IN WHICH THE INITIAL DOSE WAS 15 GRAINS OR MORE (MULTIPARAE)

CASE NUMBER	AGE	PARITY	COMPLICATIONS OF PREGNANCY	P.P.	FIRST STAGE	SECOND STAGE	TERMINATION OF LABOR	TOTAL DOSAGE GRAINS	SUPPLEMENTAL ANESTHETIC	RESULTS
85095	31	vii	0	O.L.A.	4 <sup>h</sup> 5 <sup>m</sup>	35 <sup>m</sup>	Spontaneous	18	130 gallons nitrous oxide	Excellent
85087	22	ii	0	O.L.A.	4 <sup>h</sup> 30 <sup>m</sup>	15 <sup>m</sup>	Spontaneous	18	45 gallons nitrous oxide	No (b)
85010	35	x	0	O.L.A.	3 <sup>h</sup> 45 <sup>m</sup>	7 <sup>m</sup>	Spontaneous	15	Very small amount nitrous oxide	Excellent
85225	30	x	Preeclamptic toxemia	O.D.A.	8 <sup>h</sup> 30 <sup>m</sup>	8 <sup>m</sup>	Spontaneous	21	No	(a)
85276	23	iii	Preeclamptic toxemia	O.L.A.	2 <sup>h</sup> 41 <sup>m</sup>	12 <sup>m</sup>	Spontaneous	24	Very small amount nitrous oxide	Excellent
85299	38	viii	Preeclamptic toxemia	O.L.A.	11 <sup>h</sup> 20 <sup>m</sup>	32 <sup>m</sup>	Spontaneous	30	Very small amount nitrous oxide	Excellent
85387	26	iv	Preeclamptic toxemia	O.D.A.	2 <sup>h</sup> 35 <sup>m</sup>	25 <sup>m</sup>	Spontaneous	15	60 gallons nitrous oxide	Good
85462	23	ii	0	O.L.A.	6 <sup>h</sup> 0 <sup>m</sup>	1 <sup>m</sup>	Episiotomy, low forceps	24	60 gallons nitrous oxide	Excellent
85447	36	ix	0	O.L.A.	10 <sup>h</sup> 40 <sup>m</sup>	5 <sup>m</sup>	Completion of dilatation with Voorhees bag	30	75 gallons nitrous oxide	Excellent
85511	20	ii	0	O.L.A.	6 <sup>h</sup> 45 <sup>m</sup>	5 <sup>m</sup>	Spontaneous	18	110 gallons nitrous oxide	No (d)
85640	24	iii	0	O.D.A.	3 <sup>h</sup> 0 <sup>m</sup>	15 <sup>m</sup>	Spontaneous	18	20 gallons nitrous oxide	Good (b)
85697	30	vii	0	O.D.A.	0 <sup>h</sup> 25 <sup>m</sup>	10 <sup>m</sup>	Spontaneous	18	Whiffs nitrous oxide for 5 minutes	No (b)
85748	24	v	0	O.L.A.	2 <sup>h</sup> 30 <sup>m</sup>	17 <sup>m</sup>	Spontaneous	18	40 gallons nitrous oxide	No (c)
85567	27	ii	0	O.L.A.	3 <sup>h</sup> 25 <sup>m</sup>	40 <sup>m</sup>	Episiotomy, low forceps	24	60 gallons nitrous oxide	Excellent
85015	22	iii	0	O.L.A.	1 <sup>h</sup> 25 <sup>m</sup>	10 <sup>m</sup>	Spontaneous	18	No	Excellent
85799	26	ii	0	O.D.A.	3 <sup>h</sup> 15 <sup>m</sup>	4 <sup>m</sup>	Spontaneous	18	60 gallons nitrous oxide	Excellent
69457	31	viii	0	O.D.A.	4 <sup>h</sup> 5 <sup>m</sup>	35 <sup>m</sup>	Spontaneous	18	130 gallons nitrous oxide	Excellent
85279	26	ii	Preeclamptic toxemia	O.L.A.	1 <sup>h</sup> 30 <sup>m</sup>	2 <sup>m</sup>	Spontaneous	18	60 gallons nitrous oxide	No (c)
85316	39	xiv	Preeclamptic toxemia	S.L.A.	0 <sup>h</sup> 33 <sup>m</sup>	17 <sup>m</sup>	Breech extraction	18	20 gallons nitrous oxide	No (c)

(a) Patient went into shock.

(b) Drug administered too late to give good effect.

(c) Rapid labor.

(d) Patient had definite resistance to sodium amytal; no effect at all noted.

though the patient was given moderate relief from the pains; *good*, in the cases in which the amnesia was not quite perfect and the patient remembered a few isolated facts about the labor; *excellent*, where the amnesia was perfect.

In the series in which the initial dose was nine grains, there were seventeen cases. Only one of these patients received an excellent effect. Here the patient received nine grains and an additional six grains preparatory to the induction of labor and, consequently, received fifteen grains before labor began. Another twelve grains were received during labor, making a total dosage of twenty-seven grains.

In our series of 14 primiparae who received an initial dose of fifteen or eighteen grains, 12 got excellent effect. The 2 patients in whom no effect was obtained were not fair trials, as both labors were rapid, one five hours and thirteen minutes and the other three hours and forty-five minutes. In both cases the drug was not administered until the patients had been in labor from two to two and one-half hours and the total dose was only fifteen grains.

In our series of 19 multiparae, who received an initial dose of fifteen or eighteen grains, excellent results were obtained in 10. In our 9 failures, 2 patients showed definite idiosyncrasy and will be discussed further. In 2 cases the results were good, the amnesia not being quite perfect. A further factor in one of these cases was rapid labor and late administration. In the other 5 cases in which the results were not excellent, the explanation lay in rapid labor and late administration of the drug.

*Idiosyncrasy.*—As mentioned, 2 of our patients showed definite idiosyncrasy.

One patient proved definitely resistant to the action of sodium amytal, although a total of thirty grains was administered and the initial dose was given sufficiently early. The labor lasted ten hours and forty-five minutes, during the period of which the patient was quite rational and described the labor afterward as her hardest.

Another patient with a moderate toxemia of pregnancy and a blood pressure at the onset of labor of 150/110 went into shock after a total administration of twenty-one grains, her blood pressure falling to 80/40. She required two intravenous infusions and ephedrin to restore her from this vasomotor collapse.

#### SUMMARY

1. Oral administration of sodium amytal in labor is probably just as satisfactory as by the intravenous route.
2. The difference of only a few minutes in rapidity of action when given orally as compared with the intravenous administration is not sufficient to influence its effect in labor, except in the most stormy labors.



3. The depth of narcosis depends rather on the dose employed than on the method of administration.

4. Labor has apparently not been prolonged nor have operative deliveries increased. No postpartum hemorrhages have occurred.

5. No untoward effect on the baby has been noted.

6. Marked variations in susceptibility occur and there may be definite idiosyncrasies. For this reason the patient should be carefully watched during the period of narcosis and blood pressure readings taken regularly.

7. Complete amnesia and a moderate amount of analgesia can be obtained in the vast majority of cases. The anesthesia cannot be relied upon.

8. The initial dose probably must be as large as fifteen grains and a total of thirty grains during labor may be administered with comparative safety.

9. Restlessness is probably the greatest drawback to the use of sodium amytal in labor and apparently occurs in the majority of cases. Our experience is that this is no more marked where administration is oral than where the intravenous route is chosen.

10. As this work is based on only fifty cases, further work is necessary to establish the proper dosage, method of administration, the desirability of combinations with other drugs, and finally, to evaluate its worth in the relief of the pains of labor.

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## THE BERCOVITZ TEST IN PREGNANCY

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BERCOVITZ, in an address before the Section of Obstetrics and Gynecology of The New York Academy of Medicine on January 28, 1930, outlined certain "Studies on the pupillary reactions of pregnant and nonpregnant women and their practical application in the diagnosis of pregnancy." It occurred to one of us (A.J.G.) to try the Bercovitz test on a series of women attending the Prenatal Clinic of the Newark City Dispensary. As in all large prenatal clinics, a great many patients appear for examination because of suspected pregnancy and are later found to be not pregnant. It was decided to do the test on all the patients, pregnant and nonpregnant, in order to find out whether all pregnant women gave a positive reaction or at least what percentage, and whether the nonpregnant women were negative to this test. In other words, we realized that if the Bercovitz test proved reliable, we had at our disposal a diagnostic procedure for pregnancy, simple and not time-consuming as the Zondek-Aschheim test or some of the other widely used tests for pregnancy.

The technic as described by Bercovitz was used. One drop of 10 per cent sodium citrate solution was mixed with five drops of the patient's blood and instilled into the patient's right eye, the left eye being used as a control. As Wassermann tests are done routinely on all our prenatal patients, we had our technician withdraw an extra specimen of blood to be used for the Bercovitz test. This procedure obviated the necessity of subjecting the patients to the further annoyance of having their fingers punctured. The reaction sought was either a dilatation of the right pupil or a contraction, as compared with the control. This reaction, in positive cases, came on in from two to five minutes. We must emphasize here the point that Bercovitz makes, to examine the pupils of both eyes before making the test, so as to see whether the pupils are equal, the reason being obvious. The patient must be examined under a soft mellow light, as a light too bright or glaring would spoil the reaction. In our series the patient was instructed not to look at the light but at some fixed object in the corner of the room, the light falling on the patient's eyes.

The test was performed on 110 consecutive patients examined at our clinic. Owing to an error of our filing clerk twenty of the cards could not be obtained at the time of writing this paper, so for statistical

purposes the results in only 90 cases are reported. Only cases which gave a definite and clean-cut reaction are classed as positive. Those cases which gave a suggestion of a reaction are classed, "doubtful." Many of the "doubtful" reactions occurred in negro women, in whom, at times, it was very hard to read the pupil, particularly in those of a very black complexion. There is a great probability, in our minds, that many of these were actually positive. Those patients whose pupils apparently gave no semblance of a reaction were classed as "negative." All periods of pregnancy are represented, from four to six weeks to nearly term, besides those cases which upon examination were found to be not pregnant. In our series, no patient who was found to be *not pregnant* at the first examination or subsequent examinations gave a *positive* reaction, this agreeing with Berecovitz's findings as reported at the 1930 meeting of the A. M. A. Several definite cases of pregnancy gave negative reactions.

Total number of cases tested	110
Total number of cases reported	90
"Positive" reactions	58 (64.44%)
"Doubtful" reactions	13 (14.44%)
"Negative" reactions	19 (21.11%)

#### SUMMARY AND CONCLUSIONS

1. A statistical report of the Berecovitz test in pregnancy, based on 90 cases is submitted.
2. Of these, 64 per cent plus gave positive reactions, 14 per cent plus were doubtful, and 21 per cent plus were definitely negative.
3. All the nonpregnant cases gave negative reactions.
4. We believe that many of the "doubtful" reactions in pregnant negro women were probably positive, and would have been interpreted so in white women.
5. It is our opinion that the Berecovitz test is a valuable aid in cases where the diagnosis of pregnancy is in doubt. It is simple, quick, and can very easily be done in the office or large clinic.

We wish to thank our technician, Mr. Jacob Schaeffer, and our nursing staff of the clinic for their cooperation in this work.

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## THE TETANOID SYNDROME AND ITS RELATION TO MENSTRUAL CRAMPS

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**I**N A RECENT preliminary report<sup>1</sup> on the tetanoid syndrome in obstetrics the symptoms were described and a number of case reports given illustrating their clinical occurrence.

Five symptoms are included in the syndrome. They are cramp-like pains in the legs and thighs, an irritability of disposition unusual in the patient, insomnia, parasthesias of the extremities, and often an edema of the extremities apparently not associated with the heart or kidney pathology.

Tetany is described by Falta and Meyers as "an abnormally increased condition of excitement of the nervous system, which is demonstrable in a heightened excitability of the motor, sensible, sensory, and vegetative nerves, and under certain circumstances in parasthesias and bilateral intermittent, for the most part painful, spasms, with intact consciousness, or which become manifest through phenomena of irritation on the part of the vegetative nerves. To the picture of tetany belong also trophic and certain metabolic disorders. The manifestations are the result of an insufficiency of the parathyroid glands."

The classification of the syndrome is based upon its resemblance to the phenomena characteristic of tetany, and upon the reaction of individuals having such symptoms to the therapeutic agents used for the treatment of tetany. The relationship between the five symptoms and tetany was briefly discussed in the preliminary report referred to above.

The present paper reviews the incidence of such symptoms in a consecutive series of 240 pregnant women seen at the Wilder Dispensary over a period of one year. Although a few of the more severe cases have been treated, and a small number have been seen through labor and the puerperium, the chief concern throughout has been on the incidence of the syndrome and its possible relation to other factors. Each patient was questioned regarding the five symptoms, on the condition of the teeth, and on the menstrual history. Notes on treatment and on labor and the puerperium were made in a very limited number. The nature of the rôle played by calcium in these relationships, its chemical structure in metabolic processes, the significance of its influence upon capillary permeability, its function in the nervous system are the subjects of an extensive and rapidly growing literature; references to this literature are deliberately omitted since the purpose of this paper is to present a single clinical relationship.

A numerical value was assigned the various symptoms and they were graded according to their severity. There is a certain arbitrary value to these grades, but they are based on a scale which has been followed consistently. Thus, in grading cramps, the value 1 was given if mild cramps occurred in one extremity, 2 if in two extremities, etc.; if more severe, the value was multiplied by two. The same method was followed for edema and parasthesias. For insomnia and irritability the values were necessarily more arbitrary, but again, such as they were, they were followed consistently by a single observer throughout. The value 1 was given to either of these symptoms when the patient recognized a change from her usual habit in sleep or temper; the maximum value of 10 was given to those in whom an almost complete lack of control was shown even in the dispensary by fidgeting, weeping, and dwelling

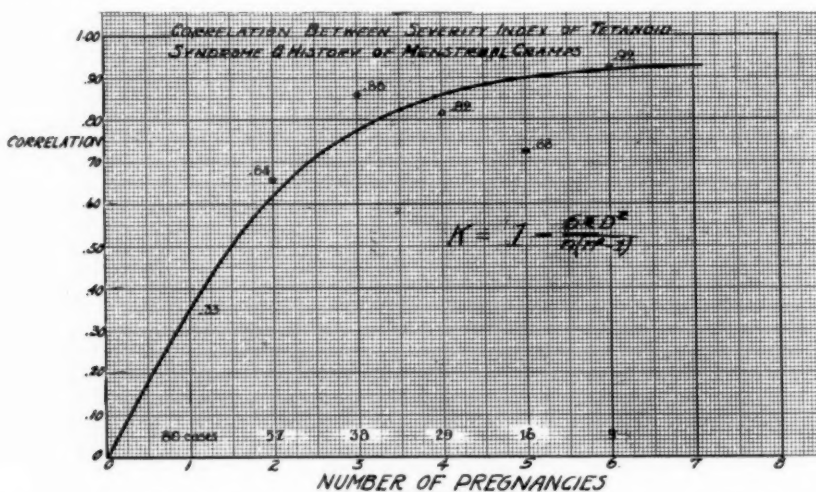


Fig. 1.—Curve showing increase of correlation with the gravidity of the patient.

upon rather pointless fears and anxieties. With the factor of pain during menstruation a maximum value of 10 was given to those who were forced to go to bed for several days at that time and who looked forward with dread to their periods; the value 1 was given when a patient had an occasional cramp to which she paid but little attention.

At the close of the year the case histories were grouped according to the gravidity of the patient into six groups. The number of those in the entire series who were gravid seven or more were too few to lend themselves to comparison.

For each patient a *severity index* was found by adding the values ascribed to the five symptoms in the syndrome. After arranging and classifying the various data, the factor menstrual cramps was chosen for comparison with the severity index for two reasons: first, because a question to the patient as to the presence or absence of cramps could be answered more definitely and with fewer qualifications than any

other, and secondly, because in looking over the assembled data there appeared to be a greater likelihood of finding a significant relationship in that factor. The coefficient of correlation was then found between the weighed factors severity index and menstrual cramp value according to the formula.

$$K = 1 - \frac{6 \sum d^2}{N(N^2 - 1)}$$

In which  $K$  = the coefficient of correlation.  $6 \sum d^2$  = the sum of the deviations between the rank order of the two factors squared, and  $N$  = the number of cases.

Correlation coefficients may range from a minus one to a plus one. A minus one shows an inverse relationship, zero indicates a complete absence of relationship, while a plus one value indicates a perfect cause and effect relationship. In speaking of this method of looking for relationship between sets of phenomena, Karl Pearson<sup>2</sup> says: Phenomena of any sort "are contingent, and the problem . . . is to measure the degree of this contingency, which we see lies between the zero of independence and the unity of causation." In the instance here given the degree of contingency as measured by correlation is high, and approaches the unity of causation. The word "cause" is used here not in the sense of a "force," but in the sense in which John Stuart Mill defines causation as "uniform antecedence." As expressing a high degree of antecedence, the coefficients here given have a routine and sequence indicating a clinical value.

Women in the first group (gravid one) have a coefficient lower than the rest, but still high enough to be significant of a definite dependence of the two sets of factors. This coefficient rises rapidly with each succeeding pregnancy to approach, but never reach, the unity of causation.

Considered from a clinical point of view, one would apparently be justified in telling a patient seen early in her first pregnancy, whose history showed that she had had menstrual cramps, that she would very likely suffer from one or more of the symptoms of the syndrome. For each succeeding pregnancy, having a similar menstrual history, one might expect these symptoms with enough confidence to warrant an early use of appropriate treatment as an anticipatory measure to prevent, if possible, the occurrence of symptoms otherwise practically inevitable.

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625 LOWRY MEDICAL ARTS BUILDING.



## PRIMARY CARCINOMA OF THE VAGINA IN A GIRL OF FOURTEEN

WITH A CONSIDERATION OF THE AGE INCIDENCE OF 905 CASES OF  
CARCINOMA OF THE UTERUS, VAGINA AND VULVA

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**P**PRIMARY carcinoma of the vagina at any age is uncommon, and below twenty is extremely rare. It is for this reason that this case is being reported.

Mrs. V. L., married, born February 28, 1914, entered the University Hospital as an emergency on November 21, 1929. Her family history was negative for cancer although her mother had been told she had a uterine tumor. Prior to the present illness the patient had always been well with the exception of the children's diseases. At the age of eight she injured the base of her spine by falling, and has complained of occasional pain in her spine since that time. She has lost forty-three pounds in the last year, weighing one hundred and twenty pounds on admission. Her menstrual life started at thirteen, regular at first, of twenty-eight day interval and lasting six days. She was married in November, 1928, and has had one pregnancy, terminated by cesarean section in July, 1929, the child dying nine hours after birth.

Her chief complaints were pain in the right hip, back, vagina and uterus; frequency and dysuria. Soon after marriage she complained of a bloody vaginal discharge and dyspareunia. In January, 1929, backache and pain in the vagina began. She was then two and a half months pregnant. She consulted Dr. H. L. Snyder of Winfield, Kansas who performed a biopsy which was reported as medullary squamous cell carcinoma. At that time the cervix was free, and the malignant process was confined to the right vaginal wall. Radium was administered by Dr. O. W. Swope, of Wichita, Kansas, but the patient did not return for further treatment.

Examination on admission revealed a well developed but poorly nourished girl. The skin was pale and dry, but otherwise general examination was negative. Vaginal examination was attempted without anesthesia, but was unsatisfactory. Under an anesthetic, the entire right side of the vagina from just within the hymenal ring to the vault was seen to be involved in a friable necrotic mass. Likewise the right side of the cervix and to a lesser extent the left, were involved. The right broad ligament was markedly infiltrated, and there was some involvement of the left. Biopsy again confirmed the diagnosis. The case was considered inoperable, and was treated with x-ray. Her condition gradually became worse and her weakness progressed. The bloody discharge became less and ceased. On April 26, 1930, she called the nurse to inform her that she was again bleeding. A few minutes later she was dead as the result of a massive hemorrhage. Autopsy showed that the malignant growth had completely destroyed the soft tissue in the right pelvis, the sacrospinous ligament being exposed. The right ureter was surrounded by the newgrowth with resultant hydronephrosis. No gross metastasis to distant organs could be seen. The most notable feature of the autopsy was the complete exsanguination of all tissues.

Through the kindness of Dr. Snyder, we were able to submit a slide of the original biopsy, together with our own, to Dr. Aldred Scott Warthin for diagnosis. Both of these he considered as medullary squamous cell carcinoma.



In 1919 Dr. Reuben Peterson<sup>1</sup> reviewed 500 cases of uterine cancer and analyzed them in reference to age. The incentive for his paper had been a case of squamous cell carcinoma of the cervix in a woman of twenty-one. To the above series 405 cases of carcinoma of the uterus, vagina and vulva have now been added from the Department of Obstetrics and Gynecology, University Hospital, from 1919 to 1929. These include only those cases that have been proved microscopically, and are by no means a complete list of the cases seen.

The age distribution of the 905 cases will be considered under the following headings: (1) Total number of cases, (2) carcinoma of the uterus, (3) carcinoma of the cervix, (4) carcinoma of the fundus,

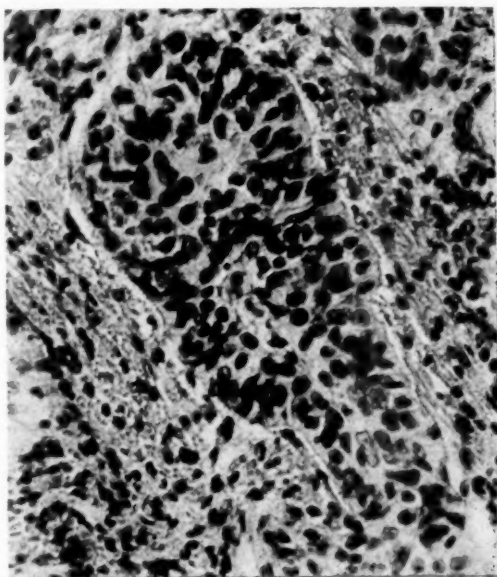


Fig. 1.—High power photomicrograph of specimen removed for biopsy.

(5) squamous cell carcinoma of the cervix, (6) adenocarcinoma of the cervix, (7) carcinoma of the vagina, and (8) carcinoma of the vulva.

The age distribution has been divided into five-year periods, the first multiple of five being inclusive; for example, the period from 30 to 35 includes ages from 30 to 34 inclusive, but not 35, which is included in the next period.

Table I shows the age distribution of all 905 cases. The highest number of cases falls between 50 and 55, while 61.4 per cent occur between the ages of 40 and 60.

There were 867 cases of carcinoma of the uterus, both cervical and fundal, there being 722 cases of the former and 145 cases of the latter. Again the highest group is from 50 to 55. This series shows a slightly lower percentage of fundal cases than did Peterson's article,

mentioned above. However, Smith and Grinnell<sup>2</sup> found in 649 cases a ratio of 1 fundal to 4.46 cervical, while Koblank<sup>3</sup> reports a ratio of 1 to 10 and Mahle<sup>4</sup> in 855 cases found 30 per cent to be fundal.

In the cervical carcinoma, both squamous cell and adenocarcinoma, the maximum number of cases falls between 40 and 45, with 47.28 per cent between 40 and 55. If these cases are divided into their component groups one finds that the squamous cell variety still has the same age predominance, while the group of adenocarcinoma has an equal preponderance from 40 to 45, from 50 to 55 and from 55 to 60.

One would expect the fundal cases to have an older age selection which is borne out in the present series, 26.89 per cent being between 55 and 60. After 60 there is a sudden drop in the number of these cases. This series is unusual because of 14 cases under 40, as Donald and Shaw<sup>5</sup> in 177 cases found only one below 40.

TABLE I. AGE DISTRIBUTION OF 905 CASES OF CARCINOMA OF UTERUS, VAGINA, AND VULVA IN THE UNIVERSITY OF MICHIGAN HOSPITAL, CONFIRMED BY MICROSCOPIC EXAMINATION

AGE	TOTAL	UTERUS	CERVIX	FUNDUS	SQUAMOUS CELL CERVIX	ADENO-CERVIX	VAGINA	VULVA
10-15	1						1	
15-20								
20-25	11	11	10	1	8	2		
25-30	35	33	31	2	27	4	2	
30-35	61	60	57	3	55	2		1
35-40	104	101	93	8	86	7	1	2
40-45	146	141	127	14	118	9	3	2
45-50	127	124	110	14	104	7	1	2
50-55	152	145	119	26	110	9	1	6
55-60	131	128	89	39	79	9	1	2
60-65	75	72	50	22	47	2		3
65-70	44	36	25	11	22	4		8
70-75	8	7	4	3	4			1
75-80	9	8	6	2	6			1
80-85	1	1	1		1			0
Total	905	867	722	145	667	55	10	28

Only 10 cases of primary carcinoma of the vagina proved by microscopic examination have been seen in this clinic in the past 29 years. Of these, 3 occurred between 40 and 45, and 2 between 25 and 30. The present case is the only one under 25.

Of the 28 cases of vulval carcinoma the greatest number occurred between 65 and 70, there being 8 in this group; and 6 between 55 and 60. There were no cases below 30.

A careful review of the available literature has been made of all cases of carcinoma in the above locations, at or below the age of 20.

Bonner<sup>6</sup> in 1927 reviewed the literature for uterine carcinoma in the young, Rentschler<sup>7</sup> in 1929 wrote on epitheliomas of the vulva and included the young cases; Kehrer and Neumann<sup>8</sup> in 1929 considered both sarcoma and carcinoma of the uterus in children, and recently Morse<sup>9</sup> has discussed all cases below the age of 10.

Only 2 cases of primary carcinoma of the vagina at 20 or younger could be found. Ward<sup>10</sup> reported a case at 20, and stated that 2 cases had been reported at 14 and 17 respectively, but gave no references and these cases have not been located. He described his case as an epithelioma of the infiltrating type. The patient had complained of dyspareunia and vaginal bleeding. Heckford<sup>11</sup> in 1868 reported a case of medullary carcinoma of the vagina in a child of 10 months. An autopsy was performed, the report of which stated that there were villous looking growths protruding from and greatly distending the vagina.

There are 4 cases of carcinoma of the fundus that demand mention. The youngest was reported by Kehrer and Neumann.<sup>8</sup> This case was a child fifteen months of age. The authors describe the malignancy resembling a sarcoma for the most part, but with some alveolar structures resembling carcinoma. They conclude that the growth was a carcinoma, whose unripe cells showed a tendency to differentiate into structures varying morphologically. Taussig<sup>12</sup> reported a case of adenocarcinoma of the fundus at nineteen years, the diagnosis of which was confirmed histologically. Rösle<sup>13</sup> reported a case ten years of age, having a tumor the size of a child's head and occupying most of the pelvic and abdominal cavities. This was removed and even microscopically no adnexa could be found. There were metastases to the peritoneum, pleura, and diaphragm. He himself questioned the diagnosis, stating that the cells were embryonal in character and not like ordinary carcinoma cells and resembled ovarian carcinoma and the interstitial cell sarcoma of the testes.

Von Hansemann<sup>14</sup> reported a patient of Koblack's seventeen years of age. Curettage had shown a definite epithelial carcinoma of the body of the uterus.

The cervical cases below twenty are more common although the reports of several are not satisfactory. The youngest case is that of Bumm,<sup>15</sup> an adenocarcinoma at seven months. This patient was operated upon but died of pyelitis. Aschheim<sup>16</sup> confirmed the diagnosis microscopically. This same case has been reported by Bertkau<sup>17</sup> but is given as eight months.

Philipp<sup>18</sup> reported a case of Pfaunder's three and one-quarter years of age. She was healthy and strong but pieces of tissue had been passed from the vagina. These were diagnosed as adenocarcinoma and the uterus was removed. Durek diagnosed the condition microscopically as an endothelioma of the portio vaginalis and posterior vaginal fornix.

McDonald<sup>19</sup> and more recently Morse<sup>9</sup> have reported a case of adenocarcinoma of the cervix in a child of ten. This child had been admitted because of a gonorrheal vaginitis of two years' standing. The discharge had been bloody on two occasions. The abdomen was distended and there was tenderness over the bladder. There was a watery, blood-stained discharge associated with pieces of tissue. Vaginal examination revealed a soft friable mass on the cervix. Microscopically this proved to be an adenocarcinoma. An exploratory laparotomy showed that the uterus was five times normal size but it was impossible to remove it.

Glöckner's<sup>20</sup> case was reported by Margelsberg. This patient was seven years old and had had vaginal bleeding since the age of four. A radical panhysterectomy was performed and the upper one-third of the vagina was removed. She was free for four years and then developed inguinal metastases. The diagnosis of adenocarcinoma of the anterior cervical wall extending into the vagina was confirmed microscopically by Robert Meyer.

Ganghofer's<sup>21</sup> case at eight years also seems authentic. This child had had vaginal bleeding for two or three years. The tumor was the size of a hazelnut and projected into the vagina. The tumor was removed and Chiari reported the pathology as a medullary adenocarcinoma of the cervix.

Bonner<sup>6</sup> has reported an unquestionable case at thirteen years. The patient had previously been treated for "ovarian dyscrasia" and vaginal examination had been

neglected. The menstrual cycle had started at eleven years of age and was associated with pain in the lower left quadrant. When twelve years of age a thick cream-colored discharge appeared which persisted. Two months later she had a profuse vaginal hemorrhage, which was repeated. When first seen by Bonner vaginal examination showed a cauliflower type of growth the size of an orange, located on the cervix. This growth together with the entire intravaginal cervix was removed with a cautery and radium and x-ray administered. Nineteen months later there was no evidence of recurrence. The diagnosis of adenocarcinoma was supported by Lederer, L'Esperance, and Ewing.

Aguinaga<sup>22</sup> has reported a case of carcinoma of the cervix in a girl of fourteen years. Diagnosis was made by biopsy, but the type of malignancy is not mentioned. The tumor was removed, followed by cauterization and radium, and there were no metastases thirteen months after operation. Little<sup>23</sup> also reported a case of carcinoma of the cervix at the age of fourteen. It has not been possible to consult the original but references state that no histologic examination was made.

In 1926 Lisa and Cornwall<sup>24</sup> reported a case of squamous cell carcinoma of the cervix in a child of sixteen. There were metastases to the lungs, heart, spleen, and liver.

There are four cases reported at eighteen years, by Cragin,<sup>25</sup> Boyd,<sup>26</sup> Wells,<sup>27</sup> and de Rouville,<sup>28</sup> respectively.

Cragin's case was confirmed microscopically by Frances Carter Wood. This patient had had hemorrhages for several months, and a large cauliflower mass was found extending from the cervix. Biopsy was performed, followed by radical panhysterectomy. Four months later there was no evidence of recurrence.

De Rouville's case had had irregular metrorrhagia for six months. This had been associated with a discharge which had become fetid. For two months she had had vague pain in the lower abdomen. Vaginal examination revealed a vegetating tumor. Radical panhysterectomy was performed with apparent recovery at ten months. Microscopic diagnosis was an epithelioma of the cervix.

Boyd's case was presented in 1905. The patient was unmarried and had suffered from menorrhagia since the onset of her menstrual life, four and one-half years previously. Five weeks prior to admission the patient had noticed something protruding from the vagina, and the discharge which had been present became offensive. Examination showed a growth the size of a small walnut, attached to the anterior cervical lip by a broad pedicle. The cervix was amputated, and later the uterus and right ovary were removed per vaginam. The original pathologic report was adenocarcinoma but later was changed to endothelioma. The pathologic committee of the London Obstetrical Society reported that portions of the tumor resembled ordinary papillary adenocarcinoma, while other portions suggested that the growth began in the endothelium of the blood vessels.

Wells's patient had recently been married, her menstrual period had begun a few days late and then she had had profuse vaginal bleeding. A diagnosis of an abortion was made and a curettage was performed. This showed an adenocarcinoma at the level of the internal os. A radical vaginal hysterectomy was then done. The patient was reported as well four years later.

Eckardt<sup>29</sup> and Tschop<sup>30</sup> have both reported cervical cancer in individuals nineteen years of age. Tschop's patient had fallen downstairs four months before admission. This fall had resulted in loss of blood from the vagina and exhaustion. Following this the patient had noticed a discharge and small loss of blood when at stool. Examination showed that the larger portion of the cervix was covered by a dense irregular sensitive tumor. There were no metastases to the vagina or adnexa. The uterus was removed and the patient recovered. Diagnosis was confirmed histologically.

Eckardt's case was first considered as sarcoma, but finally called carcinoma. The patient's menstrual periods had been regular but profuse. A tumor the size of a child's head was found in the vagina attached by a pedicle to the cervical canal. The uterus was not enlarged.

An adenocarcinoma at twenty has been reported by Darnall.<sup>31</sup> The tumor, the size of a man's fist, was described as being of the cauliflower type and occurred in an unmarried negress. She entered the hospital because of a more or less constant flow and a sensation of fullness in the vagina. A panhysterectomy was performed. The patient died the same night of pulmonary embolism. The pathologic report was adenocarcinoma.

Gusserow<sup>32</sup> reported two cases of carcinoma of the cervix, one seventeen and one nineteen. The original reference states that these are the cases of Glatter and Beigel respectively.

Glatter<sup>33</sup> in a discussion of desirable death statistics mentions that between 1862 and 1869 in Vienna, one individual died at seventeen and one at twenty of carcinoma of the uterus. No further details are given. While Beigel<sup>34</sup> in a table of age incidence states that he has had one case of uterine carcinoma at nineteen but does not say whether fundal or cervical, and does not give any details.

Adams<sup>35</sup> reported a case of carcinoma at two and one-half years but the pathologic committee that examined the specimen considered it as a teratoma and not carcinomatous.

Engelhorn<sup>36</sup> refers to cases reported by Beigel at nineteen, Glatter<sup>33</sup> at seventeen, and Rosenstein<sup>37</sup> of the fundus at two, but does not believe that they have been proved satisfactorily.

The information concerning primary vulval carcinoma in children is very poor, and in addition, these cases seem to have been reported in the most unavailable literature.

Bietrix<sup>38</sup> has been given the credit for reporting the youngest case, in a child of eighteen months. Both Bietrix' original article and Popovitch's<sup>39</sup> reference fail to specify the exact type of tumor. However, Bietrix does state that the case was originally reported by Gaillard Thomas<sup>40</sup> who, one finds, described the growth as a sarcoma.

Kimoshita<sup>41</sup> has reported a case of epithelial cancer of the vulva in a fifteen-year-old child. This reference could not be obtained and consequently no further details are known.

Rothchild<sup>42</sup> in 1912, writing on the malignant newgrowth of the vulva and their prognosis, states that Merz<sup>43</sup> reported a case of carcinoma of the vulva at sixteen, Fileux one at five. Reported attempts to obtain Merz's original article have failed. Fileux's<sup>44</sup> case proves to be a sarcoma. Rothchild in a list of 331 cases of carcinoma of the vulva found one case between ten and fifteen and one case between sixteen and twenty.

Ossing<sup>45</sup> has reported a case of carcinoma of the vulva in a girl of twenty. Four months before admission she had been married. While on her honeymoon she first noticed a small painless tumor on the right labium. This tumor was removed two months later and a diagnosis of carcinoma made microscopically. When admitted, Ossing states that there was a deep crater-like scar in the middle of the right labium major. This was largely healed but was adherent to the bone. The edge was hard and infiltrated with nodules the size of lentils. The right inguinal glands were enlarged and tender. The inguinal glands, the right half of the labium, and most of the descending ramus of the pubes were removed surgically. The wound healed by primary union, but the patient died the same year.

Loorich<sup>46</sup> in reporting two cases of vulval carcinoma mentions that St. Germain had reported a case of carcinoma of the vulva in a child of five. A careful search has failed to reveal that St. Germain ever reported this case in the literature.



In this paper an attempt has been made to collect as many of the cases of carcinoma of the female genital tract below the age of twenty as possible. The result is necessarily somewhat incomplete due to the difficulties met in searching the literature. Nevertheless one is impressed by the number of authentic cases reported and one cannot fail to realize their significance and the importance of an early diagnosis by means of timely examinations.

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## COMBINED PREGNANCY, WITH REPORT OF A CASE

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COMBINED or compound pregnancy are terms which have been employed in the literature to denote a coexisting intrauterine and extrauterine gestation.

Novak believes that the term "compound pregnancy" should be used in a limited sense in reference to a condition in which an active pregnancy occurs in the presence of the remains of a previous gestation, as for example, an intrauterine pregnancy complicated by a lithopedion, resulting from a previous gestation. For the purpose of study, a differentiation should be made in the classification between a combined and a compound pregnancy.

As is evident, combined pregnancy is primarily a twin pregnancy, one impregnated ovum lodging in the decidua of the uterine cavity and the other finding attachment usually to the tubal mucosa. In the process of growth, complications ensue, producing symptoms which may terminate one or both pregnancies and cause the death of the mother.

Fortunately, combined pregnancy is a rather infrequent condition, so rare that few of us have occasion to observe one or more than one such complication. Perhaps the symptoms are so mild in the early stages, the extrauterine pregnancy terminating spontaneously and completely, that sufficient clinical evidence of a combined pregnancy may be lacking. Furthermore, while the ectopic pregnancy is being diagnosed, the uterine pregnancy which may or may not be aborting concurrently, is likely to be overlooked. The literature records a number of instances of unexpected uterine gestations diagnosed during or after a laparotomy for an ectopic.

Since the question of superfetation in twin uterine pregnancy cannot in most instances be proved, it becomes increasingly difficult to diagnose such a condition in combined gestation, for here we are dealing with two fetuses, whose abode and nourishment are so dissimilar that it is quite impossible, even at or near term, to diagnose a superfetation. Physically and physiologically, a superfetation is possible, but the literature fails to record such a case.

Unfortunately many of the cases appearing in the literature give but meager histories. The authors, reporting the cases merely because of their rarity, stress the operative findings and the final results.

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In a mixed series of cases it has been found that the greatest incidence of extra- and intrauterine pregnancy occurred in women between the ages of thirty-one and thirty-five years (33 per cent), and that the second pregnancy was most susceptible to this complication (25 per cent). There is probably the same hereditary factor in multiple conceptions here as in other types of human pregnancies. Some of these patients give a history of previous twin gestation. It was further observed that the tendency to interruption of pregnancy for both the ectopic and uterine types occurred most frequently during the second and third months of gestation. For the uterine pregnancy, the occurrence at two months was 13 per cent and at three months 17 per cent, while for the extrauterine type at two months it was 23 per cent and 16 per cent at three months. Only 37 per cent of the uterine and 23 per cent of the extrauterine fetations came to term. The mortality rate for the mother was 21 per cent, the uterine fetus 61 per cent, and the ectopic 96 per cent.

Duverney, in 1708, was the first to report a combined pregnancy which he found at autopsy, death resulting from rupture of the tubal sac. In 1825, Mme. La-Chapelle recorded a case of a seven-month, premature, spontaneous, uterine delivery, followed by the maternal death on the fourth postpartum day. An autopsy revealed an ectopic. Parry, in 1876, collected 23 cases from the literature. Only in the last thirty years, however, has this type of multiple pregnancy been sufficiently assembled and reviewed. Zinke, in 1902, collected 88 cases, and, in 1904, appeared Simpson's paper with a review of 113 cases; this was followed, in 1907, by Neugebauer's notable monograph of 171 cases; and, in 1913, he increased the number to 244 cases. From 1913 to 1926 Novak was able to assemble 32 cases, while from 1913 to 1928 Stein collected 36 cases. In reviewing the last two papers, it was found that 18 cases were duplicated (due of course to the similar period covered by their reports), so that in a collective sense we have up to that time 294 cases of coexisting extrauterine and intrauterine pregnancy appearing in the literature. While only 294 cases have been reported up to 1928, by far the greater number has been either unrecognized or unreported. Since we are fully aware that many twin uterine pregnancies never develop to twin births, so likewise are many combined gestations overlooked, and result in a spontaneous resolution of the ectopic or merely an exaggeration of the uterine flow.

The symptoms vary, depending upon the duration of pregnancy and the location of the interruption. As has been stated previously, early conceptions, uterine and extrauterine, may terminate with little disturbance. The pelvic condition may be attributed to a mild adnexal involvement, an intestinal or urinary tract upset, a physical or mental overexertion, etc.; and so it proceeds unrecognized to spontaneous expulsion and in the ectopic type usually to absorption. But with the advancement of the pregnancy, the symptoms of termination become more pronounced, depending upon whether the uterus or the tube is the expulsive organ. If, however, both are active in the process of interruption, then the clinical picture truly becomes confusing, and unless we are on the alert, grave results may follow. Fortunately, such cases are very few in number and the ectopic explosive type predominates. The symptoms of an ectopic abortion and rupture are pathognomonic and need not be discussed here. It is necessary only to add that with a concomitant uterine pregnancy, the passing of a uterine decidual cast is lacking, and for obvious reasons there may be a complete absence of uterine bleeding if the uterine pregnancy is undisturbed. The lack of a uterine discharge at this time should arouse our suspicion of a possible undisturbed pregnant uterus; and, on the other hand, a profuse uterine hemorrhage with ectopic symptoms should warn us of a progressive abortion in a coexisting uterine gestation. With a uterine abortion and an undisturbed ectopic pregnancy, the symptoms are those of an ordinary abortion, except that there might be evidence of a greater external hemorrhage, due perhaps to the increased congestion in the pelvis plus the indirect

action on the myometrium from a growing extra-uterine fetation. If, however, the combined pregnancy has survived the more trying early periods and has reached a stage of viability, then the symptoms are practically the same as in a twin uterine gestation, except that there may be greater discomfort produced by the ectopic, resulting from its peculiar placental attachments, from a lack of a smooth muscular inclosure, and from adhesions to the surrounding organs.

Depending upon the symptoms, the diagnosis is made either early or late. The various subjective symptoms and physical findings of an acute explosion are familiar. The degree and type of uterine bleeding may assist us in reaching a proper conclusion. The stage of the combined pregnancy, with a uterus larger than the usual size of one associated with a simple ectopic, may likewise point to the actual condition. The greatest danger lies in cases showing predominating symptoms of a uterine abortion with only mild adnexal involvement. Only the most careful history and examination will save us from dangerous pitfalls.

If the combined gestation proceeds past the first trimester, the outlook for a viable fetus under favorable circumstances may be expected. Stein's statistics show that 43 per cent of uterine pregnancies are interrupted by the end of three months as compared to 53 per cent of the ectopics, while up to the seventh month an additional 15 per cent of the intrauterine and 18 per cent of the extrauterine fetuses are lost, and after the seventh month, 42 per cent of the uterine and 29 per cent of the heterotopic pregnancies terminate. We might assume, therefore, that a near majority of such twin fetuses delivered past the seventh month have an opportunity to survive. And yet, in looking through the literature we find only 9 cases where both fetuses were delivered alive. Of this number, only 3 cases showed both a living mother and two living children at the end of two weeks. Because of the rarity of such end-results and other interesting features, I wish to report the fourth such case of combined pregnancy, terminating in the third trimester, and resulting in two living children and a living mother. But before doing so, it might be advisable to discuss the treatment.

As in a simple ectopic, the indication for surgical interference in combined pregnancy in the early months is the recognition of the heterotopic pregnancy. At this time, the extrauterine conception is seldom diagnosed, unless symptoms of its separation become evident. Although in many instances the uterine pregnancy is not recognized preoperatively, the extirpation of the internal bleeding area must proceed, even in the knowledge of a coexisting uterine pregnancy, care and gentleness being employed in handling the impregnated uterus.

The uterine pregnancy is less likely to be disturbed in cases of tubal abortion, while a tubal rupture near the proximal end of the tube will usually effect a termination of the uterine pregnancy. The nearer the site of the tubal involvement is to the uterus, the greater is the possibility of a uterine interruption. If both pregnancies are in process of termination, a laparotomy preceded by a gentle curettage has been recommended. A curettement at this time seems to be a questionable procedure. If at all possible, a genuine conservative attitude in the management of the uterine abortion should be the method of choice. Some operators have attempted the removal of the ectopic disturbance by the vaginal route, proceeding through the pos-

terior fornix. In an uncomplicated ectopic such a procedure is difficult and unsatisfactory, requiring at times a laparotomy to complete the operation. With an additional uterine pregnancy, the vaginal route should be completely relegated so as not to disturb further the normal pregnancy.

A combined pregnancy in the later months of gestation with living fetuses and no symptoms of termination should be carefully observed in a well-equipped institution until viability is beyond question and then a laparotomy for the removal of both babies is probably the preferable procedure; although in undiagnosed cases, following a vaginal delivery and later recognizing a living ectopic, a laparotomy has been performed with the removal of a living baby. The literature fails to record an instance in which there was interference with the vaginal delivery by the extrauterine pregnancy, although the process of the uterine expulsion may somewhat affect the opportunity for a successful laparotomy later.

At the present time there is complete accord that a laparotomy is indicated for a viable heterotopic fetus, but there is some dissension as to the proper disposition of the abdominal placenta and membranes. Since in many instances the placenta is attached near the site of its original implantation, such as to the broad ligament, hemorrhage may be controlled during and after its separation by proper hemostasis of vessels in the broad ligament. When, however, such attachments are found to the intestines, region of aorta, liver, etc., the removal of the secundines becomes distinctly a very hazardous and unwise procedure, resulting in a high maternal mortality. In such instances it is advisable to ligate and cut the cord as close to the placental origin as possible and permit the placenta and membranes to remain in the peritoneal cavity. Some operators further advocate the closure of the abdomen without drainage. If infection does not occur, absorption follows in a comparatively short period of time. Others advise gauze packing of the amniotic sac, marsupialization of the sac to the peritoneal edges of the abdominal opening, and drainage.

In 164 collected cases of celiotomy in advanced ectopic pregnancy with a living child, Sittner draws the following conclusions:

- 30.7 per cent maternal mortality in cases of marsupialization of sac.
- 6.8 per cent maternal mortality after removal of placenta and securing blood vessels.
- 5.7 per cent maternal mortality after removal of placenta and sac.

The marked difference in the above maternal mortality rate would tend to give the impression that all patients should have complete removal of the secundines to improve their opportunity for recovery. It seems more likely, however, that the higher mortality is due to the unfavorable site of the placental attachment, preventing its separation

and removal, and therefore productive of more profuse bleedings and of more frequent infections. The mortality rate appears to be affected more by the location of the placental implantation than by the employment of any special method of treatment. On the other hand, if the fetus has been dead for some time, the placenta is readily separated and its removal is a very simple procedure, resulting in little or no hemorrhage.

In opening the amniotic sac for the removal of the fetus, the usual precaution is taken to pack off, so as to limit the escape of amniotic fluid into the peritoneal cavity. Usually oligohydramnios is present, although Lindfors, quoted by Blacker, reported an uncomplicated ectopic pregnancy in which there were 11 or 12 liters of amniotic fluid.



Fig. 1.—The ectopic fetus with flattening of left side of head, neck, chest, etc.



Fig. 2.—Shows more pronouncedly the deformities of both legs.

Because of the absence of the protective mechanism of the uterine muscle, the frequent lack of a sufficient amount of amniotic fluid, the pathologic encroachment of the embryo upon abdominal tissues and also the concurrent growth of the pregnant uterus, the extrauterine fetus frequently shows malformations, contractures, flattenings, depressions, etc., the head being most frequently involved. (See Figs. 1 and 2.)

There are many other interesting features of combined pregnancy which could be taken up for discussion, as for example the conservative treatment of ectopics; pathology of extrauterine pregnancy; the employment of the vaginal exploratory puncture, etc. The scope of this paper, however, will not permit of a discussion of these phases and so I shall proceed to the case presentation.



**CASE REPORT.**—Mrs. M. S., colored, entered St. Louis City Hospital on May 31, 1929, giving her age as thirty-eight years, born in Mississippi. She had two children aged thirteen and eleven years respectively. She had had no miscarriages, and there were no multiple pregnancies on either side of the family. She had never had any serious sickness. Her previous confinements were normal. Same husband for all the pregnancies. Her menses began at the age of ten, thirty-day type, nine days' duration, profuse, and no pain. Date of last menses was questionable. Her present condition dates from Dec. 26, 1928, when she had a severe pain in the left lower abdomen which necessitated her going to bed for several days. Following this attack, she spotted intermittently for a few days. She then noticed that her abdomen was enlarging. She firmly insisted that her menstruation was regular up to the early part of April, 1929. Owing to a poor mental state, not much reliance could be placed upon her statements. She was unaware of her pregnant condition until she came to the hospital. Examination then showed a fairly well-developed woman, weighing about 135 pounds, and 5 feet tall. Physical examination was negative except that there was almost a complete absence of teeth and a pendulous abdomen containing multiple masses. The diagnosis of a twin uterine gestation was made. One was a cephalic presentation (left occiput), engaging in pelvis, and the other was a transverse presentation with the head in left mid-upper abdomen, body above, extending to the right side.

She went into labor June 7 and delivered at 7:50 P.M., O.L.A., a premature (eight months) female fetus weighing 2200 gm. The birth of the second fetus was then awaited. When no further development in the progress of the second labor was evident, consultation was asked. I saw her about twenty hours after the first delivery.

Abdominal examination revealed a transverse presentation in the upper abdomen confirmed by x-rays and also distinct fetal heart sounds, to the left and above the umbilicus. Rectal and vaginal examination showed a puerperal uterus, empty of fetal contents, lying to the right and below, and a fetal mass to the left and above. A diagnosis of a combined pregnancy was made and a laparotomy was done under ether anesthesia. With the umbilicus as a central point, an incision 12 cm. long was made to the left of it. The fetal sac was evident only in a small area, the remainder being covered by adherent bowel and omentum. The visible point of the sac was packed off and then opened. About 10 c.c. of a fairly clear amniotic fluid escaped. A female fetus weighing 1420 gm. was delivered; the cord was clamped and cut. There were spontaneous respirations. We then attempted to explore. It was found that the placenta was adherent to the descending colon, and extended over toward the region of the spine, aorta, and small bowel. A gentle maneuver in the left upper pole of the placenta to find the degree of adherence produced such severe bleeding, that it was necessary to pack and repack, finally using a Mikulicz drain. The remaining cord was then cut short and after the amniotic sac was packed, the edges of the sac were sewed to the parietal peritoneum at the abdominal opening. The abdominal wound was closed in the usual way, permitting exit for the two packs. The postoperative course was somewhat stormy, but daily improvement was noticeable. On June 19, all packs had been removed and a gauze drain was inserted to keep the abdominal wound open for necrotic drainage. On July 3, twenty-four days after operation, placental tissue was in process of expulsion through the abdominal wound and was therefore extracted. Shortly thereafter the abdominal wound was completely healed and mother and both children were discharged from the hospital.

The extrauterine fetus showed the usual effects of an oligohydramnios as well as a lack of the protective mechanism of the uterine muscle. The parts of the fetus which were in approximation to the back of the mother evidenced a marked flattening, as for example the left side of the fetal head, left part of the neck, left

shoulder, etc. Likewise, the limitation of the size of the sac produced marked deformities of the lower extremities.

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MISSOURI BUILDING.

## SPONTANEOUS EVACUATION OF PYOSALPINX THROUGH THE UTERUS

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A CAREFUL search of the gynecologic literature at my command reveals reports of but two cases of rupture of a pyosalpinx by way of the tubal ostium into the uterus and thence into the vagina. One of these cases was reported by Edward Liell,<sup>1</sup> and the second case by Hammond.<sup>2, 3</sup>

The comparative rarity of this satisfactory outcome in pyosalpinx, in which nature drains the accumulated pus for the surgeon, prompts me to call attention briefly to the condition and to report 2 cases from my clinical records.

That this condition is rare, there is no doubt. J. Bland Sutton<sup>4</sup> says that there is no trustworthy pathologic evidence that the discharges escape into the uterus by way of the tubes. Fulkerson,<sup>5</sup> Graves,<sup>6</sup> Kelly,<sup>7</sup> and Polak<sup>8</sup> make no mention of such possibilities. Anspach<sup>9</sup> says, "Under rare circumstances the pent-up pus, after reaching a certain degree of compression may be discharged through the uterine end of the tube into the cavity of the uterus. But this is not a frequent occurrence, for the infiltration of the tubal wall, the fixation and distortion of the tube which are incident to the inflammation, and the complicated peritonitis with adhesions and exudate usually block the uterine extremity."

## CASE REPORTS

CASE 1.—Mrs. R. F., aged twenty-eight, widow, one child of twelve years, prostitute, first came under my observation on September 10, 1921, complaining of "pain and soreness in the lower abdomen." Family and past history were irrelevant, except that during the previous winter she was confined to bed for two weeks with a similar complaint, which was diagnosed by the attending physician as "inflammation." Menses began at fourteen years, 28-day type, painless and regular until her illness the previous winter, since which time she has been markedly irregular, menstruating every two or three weeks with "severe cramping pains in the lower abdomen," only relieved after passing large clots. Last period ended one week before this examination, but recurred the day before.

The patient was in bed and appeared to be in pain. Temperature 99.6° F., pulse 80. Lower abdomen was slightly distended, rigid and tender, especially in lower portion. Vagina was of the relaxed marital type. Cervix was larger than normal, congested, eroded, and with a thick, blood-tinged tenacious discharge. Typical pelvic tenderness, with shortening and tenderness in both right and left fornices. A tender mass in the posterior culdesac displaced and immobilized the uterus forward and upward.

The patient was treated with rest in bed in semiprone position, elimination, ice bag, forced fluids, etc., until September 18 and irregularly at the office with tampons, etc., until February 28, 1922. She did not report for further treatment because she said she was feeling quite well.

She was next seen on February 18, 1924, complaining of pain in left lower abdomen that had been present for three days and had steadily grown worse. This had been the first recurrence of this pain since her treatment in 1922 and she had continued as a prostitute. The temperature was 103.2° F.; pulse was 100; her abdomen was distended, rigid and tender, the tenderness being most exquisite just above the symphysis in the middle line and to the left. On vaginal examination the cervix was found high in the vaginal vault against the anterior vaginal wall. There was well-defined bulging in the posterior culdesac, causing a marked vaginal shortening. The cervix was congested, reddened, eroded, and even slight movement elicited intense pain. The uterus and adnexa could not be defined. The protrusion was more marked in the left side.

The patient was again placed on palliative treatment. On February 20 she felt much relieved and temperature was 101° F. February 21 her condition was the same but temperature was 100° F. The next day the temperature had dropped to 99.8° F. February 23 she reported a restless night, with intense pain and high fever, but the following day the patient was much improved and temperature was 99.6° F. She remained in bed until March 17 with a temperature ranging from 100° F. to 99° F. and which finally became normal. Operation was advised during this quiescent period, but was refused by the patient.

On May 12, 1924, she was again forced to bed with the same syndrome of symptoms, except that the pain was more intense and radiated down her left thigh, with high fever, chills, and drenching sweats. On examination a temperature of 101° F. was noted, with increased tenderness and rigidity in the lower left quadrant. Protrusion into the vaginal pouch had increased since previous examination. The patient was treated palliatively until May 17, when it was noted that there was no improvement and she was getting progressively worse. Vaginal examination revealed that posterior bulging had increased, especially on the left side. There was marked induration of the vaginal wall and all the classic signs of pelvic abscess. Aseptic paracentesis of bulging mass showed pure pus. Posterior drainage was advised and urged and the patient consented to have it done the next morning. At 2:30 p.m. the same day, I was hastily summoned to the patient's

bedside and she informed me that she had experienced a sudden pain in her lower abdomen and felt something "give way" and shortly afterward a profuse yellow pus was discharged from the vagina with much relief of pain.

My first impression was that the pelvic abscess had spontaneously ruptured into the vagina. Very careful examination failed to reveal any rent in the vaginal wall. It was noted that pressure on the bulging posterior mass caused an increased flow of pus from the cervical canal. The cervix was cleansed and the canal aspirated, and time and time again the pus could be made to flow. Discharge continued for one week with progressive diminution in the posterior bulging and amelioration of the symptoms. Ten days later at the office pressure exerted with a sponge on a dressing forcep caused a flow of pus from the cervix. Smears showed numerous pus cells but no organisms. Recovery was rapid.

On April 5, 1926, she was given a bimanual examination and only a thickening of the posterior vaginal wall with some shortening in the posterior culdesac was found and she was quite free from symptoms. She was seen on the street about six months ago and informed me that she had not experienced any pain or discomfort and that her menses had been regular and painless.

CASE 2.—Mrs. E. B., aged thirty-five, Negro, domestic; first came under my care on March 3, 1921, for treatment for a "breaking-out" on her face and body. Past, family, and menstrual history were negative, except for a history of a suppurative inguinal adenitis on the right side, six years previously. General examination was essentially negative. She had a generalized miliary papular syphilide and her blood Wassermann was four-plus. Antiluetic treatment was arranged for, but the patient was not seen again until December 19, 1922. At this time she had an indolent, dirty gray ulcer on the inner side of the right leg about two inches above the internal malleolus. Her blood Wassermann was still four-plus. A course of six intravenous neoarsphenamine and twelve intramuscular mercury salicylate injections was given. The ulcer completely healed, but the patient did not report for further immediate observation or treatment.

She was next seen on September 2, 1924, complaining of "sickness of stomach, vomiting, and pain and tenderness in lower right abdomen." A diagnosis of subacute pelvic inflammatory disease was made and she was put to bed for two weeks with palliative treatment.

On December 1, 1924, the patient began another course of antiluetic treatments which was not completed. On November 16, 1928, the blood Wassermann was again two-plus and the patient was induced to take three intravenous neoarsphenamine injections.

She was not seen again until January 7, 1930, when she came to the office with a history of having been in bed for three weeks under the care of another physician for treatment for "pus-tubes." She complained that there were constantly present pain and tenderness in the lower abdomen, a profuse yellow discharge, and frequent, burning urination. Her last menses had ended two weeks previously after continuing for ten days.

Vaginal examination showed a marital outlet and both labiae bathed in a purulent greenish-yellow discharge. Stained smear showed gram-negative intracellular diplococci. The uterus was fixed in a mass that bulged into and markedly shortened the posterior culdesac. The cervix was congested, enlarged, ectropic, and eroded. Upon inserting and expanding the speculum blades, thereby exerting pressure on the posterior bulging, it was noticed that there was an increase in the discharge. The cervix and vagina were gently wiped dry and the speculum was again inserted, special effort being made to press the lower blade against the posterior bulging; again there was a discharge of pus from the cervix. The cleansing process was repeated with the speculum in place and pressure was exerted with a sponge on a

dressings forcep on the bulging and pus was seen to flow from the cervix. Smears from this discharge again showed an intracellular diplococci. This phenomenon could be repeated, even after aspiration of the cervix, again and again at subsequent visits until January 20. Patient was treated locally with mercurochrome-220 in 3 per cent solution. At each visit it was noted that the bulging was decreasing in size. Smear showed no evidence of gonococci on February 6. On February 25 all signs of active inflammation having subsided, a linear cauterization of the cervix was done in one stage.

She was last examined on April 5; the cauterized cervix had completely healed and there were no perceptible stigmas of gonorrhea in either the cervix, or in Naboth's or Skene's glands. The posterior bulging had entirely receded, and the uterus could be palpated but was immobilized and both right and left culdesae were somewhat shortened and other adnexa could not be palpated. The patient said that she felt fine.

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2321 EAST FIFTY-FIFTH STREET.

## REPORT OF FATAL CASE OF CHEMICAL HYSTERECTOMY\*

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**M**RS. N. R., aged forty-three, admitted to the hospital, January 21, 1930.  
*Present Illness.*—Gradual cessation of menses during the past year associated with hot flashes and generalized weakness. One month prior to admission the patient had profuse bleeding which persisted to the time of admission. Biopsy from cervix, negative for carcinoma.

*Past History.*—Chronic cholecystitis with cholecystectomy in 1926. Mucous colitis, benign adenoma of thyroid, psychoneurosis associated with menopause.

*Marital History.*—Seven children living and well. Three abortions.

*Pelvic Examination.*—External genitals normal; moderate relaxation of vaginal outlet; mild laceration of cervix with free bleeding from the cervical canal. Uterus in normal position, slightly enlarged and freely movable. Right appendage palpable but not tender.

*Laboratory Examination.*—R.B.C. 4,100,000; W.B.C. 9,400; Hg. 62 per cent; sedimentation time eighty-five minutes; P.S.P. 75 per cent total output; urethral smear negative; cervical smear negative.

*Clinical Diagnosis.*—Hyperplasia of the endometrium.

\*From the Department of Obstetrics and Gynecology, Vanderbilt University Hospital.



*Operation.*—Under spinal anesthesia a dilatation and curettage was performed. After carefully covering the vagina with gauze saturated with sodium bicarbonate solution, the uterine cavity was packed with gauze which had been soaked in 50 per cent zinc chloride solution and wrung dry. Simultaneous with the packing, the patient began retching. This was associated with a sudden severe drop in blood pressure. The only complaint the patient had was a severe burning sensation over the bladder. Respirations became very shallow, blood pressure which was originally 140/70 dropped to 70/?. Ephedrine failed to elicit any response. The pulse became weak and thready and the patient assumed a mahogany hue. The uterine packing was removed with no improvement in the patient's symptoms. The patient was given saline with ephedrine intravenously but to no avail. There was complete circulatory failure with death.

#### COMMENT

This unfortunate case did not behave as did those cases of circulatory failure which we have occasionally seen during spinal anesthesia and our clinical impression was that circulatory failure was caused by the toxic action of zinc chloride. A series of dogs were injected intra-

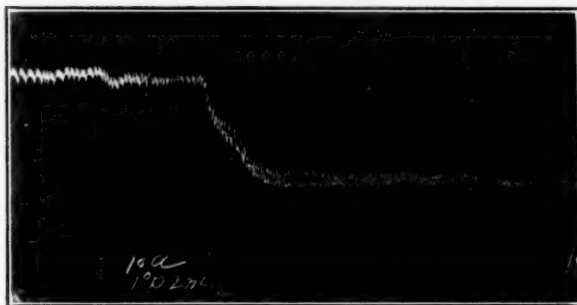


Fig. 1.—The sudden sustained drop in blood pressure due to injection of 10 c.c. of 1 per cent zinc chloride. Dog II, February 7, 1930.

peritoneally with varying amounts of 50 per cent solution of zinc chloride. These animals failed to show any immediate toxic reaction from the injection and were autopsied at the end of forty-eight hours. As was to be expected the zinc chloride had exerted a corrosive effect on the abdominal viscera.

We believe, from these experiments, that the danger of immediate toxic symptoms resulting from the regurgitation of zinc chloride solution through the fallopian tubes is practically nil. It should be borne in mind that this may occur in practice and cause a chemical pelvic peritonitis and in the course of time may cause kidney damage of varying degree. Babcock<sup>1</sup> states that there is danger from both pressure injection into the sinuses and chemical peritonitis caused by distention of the fallopian tubes. Another series of animals were anesthetized with barbital, the carotid artery being exposed and connected with a mercury manometer. Femoral veins were exposed and varying amounts of zinc chloride were injected intravenously. Three c.c. of

50 per cent solution of zinc chloride caused an immediate fall in blood pressure and death resulted in a very short period of time. Smaller amounts, as low as 10 c.c. of 1 per cent solution, always caused a sudden, sensational drop in blood pressure but death in this group was not so sudden as when larger amounts were used. It seems that when the solution was allowed to enter the blood stream, toxic symptoms appeared. This patient was curetted for diagnosis and evidently the zinc chloride obtained entrance into the blood stream through the open veins in the uterus. For this reason if this particular agent is to be used, the uterine packing should be made very loosely and curettage should not be done prior to packing. In the original article by Masson<sup>2</sup> curettage prior to the packing of the uterus was not discouraged.

In reviewing the literature numerous references as to the toxicity of the solution and fatal cases are reported by Hofmeier,<sup>3</sup> Schmid,<sup>4</sup> Buttersack,<sup>5</sup> and others. Buttersack records the case of a patient who died sixty-nine days after treatment was instituted. This patient developed a nephritis, presumably as a result of zinc poisoning. Sollman<sup>6</sup> states that when zinc is given intravenously, its chief action is paralytic. The brain is first affected while the motor areas are not involved. Blood pressure falls rapidly, but this is owing to cardiac depression.

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## A NEW CANNULA FOR TRANSUTERINE TUBAL INSUFFLATION

BY MORTIMER N. HYAMS,\* M.D., F.A.C.S., NEW YORK, N. Y.

(From the Department of Gynecology, New York Post-Graduate Medical School and Hospital)

WITH improved methods of technic, transuterine tubal insufflation has become an accepted diagnostic and therapeutic method. The development of salpingography has made it possible to visualize the uterine cavity and the lumen of the fallopian tubes. Atresia of the oviduct prevents the passage of the media, and the exact site of obstruction is clearly defined in the salpingogram.

Until recently, tubal insufflation and salpingography were considered hospital procedures. Today, with the proper equipment, either may be carried out in the physician's office, with minimum economic loss to the patient.

The instruments heretofore used for insufflation are of rigid metal construction, curved slightly at the distal end, and varying in size from 12 to 20 French.

\*Assistant Professor Gynecology.

The number of openings at the distal portion also vary, usually adapted to the diameter of the instrument.

The cervix is not uniform in size, shape, or consistency, nor is the uterus always in its normal anteverted position. Hence, the passage of a large rigid cannula into the cervix, through the internal os into the uterine cavity often results in considerable trauma to the cervix. Avenues of infection are opened for the microorganisms present in the vagina, thereby increasing possible morbidity by favoring the development of endocervicitis, parametritis, etc. Because of congenital or acquired abnormalities in the lumen of the cervix, internal os, or in the uterus itself, it is sometimes impossible to introduce a rigid instrument into the uterine cavity.

With these difficulties in mind, it seemed logical that the substitution of a flexible for a rigid instrument would be a step forward in technic. I have therefore devised an instrument which has overcome the previous difficulties and proved to be entirely satisfactory.

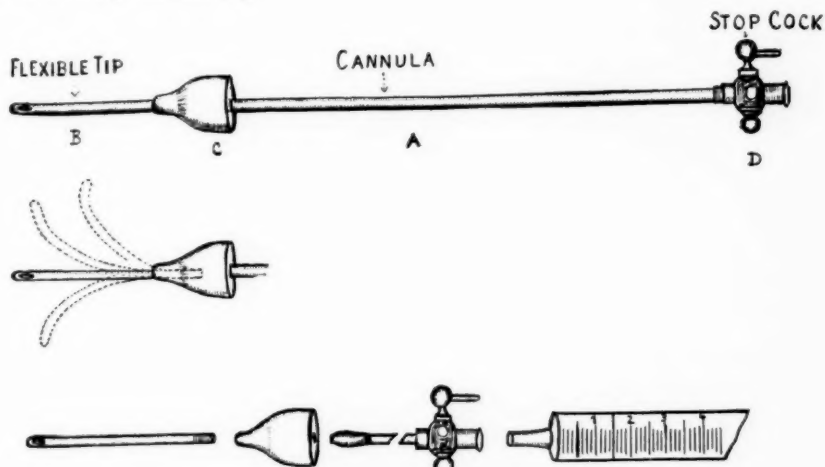


Fig. 1.

The instrument consists of a metal tube, *A*, a flexible ureteral catheter, *B*, a conical rubber irrigating tip, *C*, and a metal stopcock, *D*. The metal tube, *A*, is six inches long, size 12 French, threaded at its distal end to receive the catheter, *B*. This is a flexible ureteral catheter segment two inches long, size 9 French with a lateral and terminal eye, and screws tightly into the threaded end of tube *A*. The stopcock, *D*, is at the proximal end of the tube, *A*, and permits attachment of either a Luer syringe or a rubber bulb. The rubber tip, *C*, prevents leakage at the external os when the instrument is in use.

#### ADVANTAGES

1. The terminal portion of the instrument is semirigid but flexible.
2. The instrument may be used as part of any type of insufflation apparatus now in use.
3. By removing the rubber obstructing tip, it becomes an ideal uterine sound.
4. A minimum amount of trauma to the cervix is attended by its use.
5. Abnormal conditions of the cervical canal, internal os, or uterus cannot interfere with the passage of the flexible tip.
6. The flexible tip, being independent of the shaft, can be replaced when necessary.

78 EAST SEVENTY-NINTH STREET.

## A SIMPLE METHOD OF VAGINAL ILLUMINATION

BY NED SHINAYERSON, M.D., NEW YORK, N. Y.

VAGINAL illumination by means of a light attached to a speculum requires a special fitting to the speculum or a bulky clip with a bulb which more or less obscures the field.

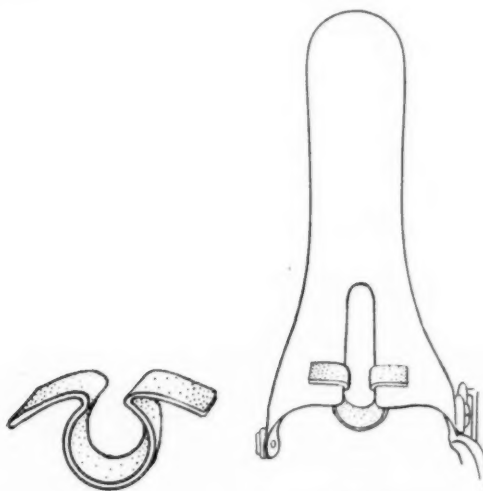


Fig. 1.

Fig. 2.

Fig. 1.—The clip itself; a cylindrical metal bar with its ends flanged to fit over the ventral blade of the speculum.

Fig. 2.—The clip as it is slipped into the ventral slit.

By taking advantage of the ventral slit in the speculum, I have devised a very simple clip which will support any illuminator of the Cameron type, in a bivalve speculum. The point of illumination occupies a minimum of space and affords clear and unobstructed vision, allowing the maximum space of a bivalve speculum for any vaginal procedure.

125 WEST SEVENTY-SIXTH STREET.

## A SIMPLIFIED METHOD OF INTRODUCING THE CARBON DIOXIDE IN THE TUBAL PATENCY TEST

BY SAMUEL HANSON, A.M., M.D., STOCKTON, CALIF.

*(From the San Joaquin General Hospital)*

IN PERFORMING the Rubin test the direct supply of the carbon dioxide from a high pressure tank carries with it certain disadvantages. In the first place, a portable tank of the gas equipped with a siphon meter is not always readily available. Second, the control of the pressure and rate of flow, even with the aid of the proper mechanical devices, is rather inconvenient, and not entirely free from danger in the hands of the occasional operator. The high pressure

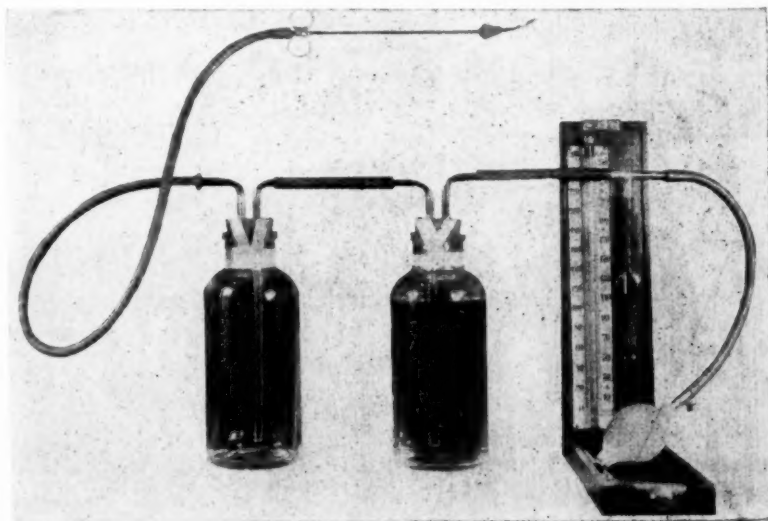


Fig. 1.

tank was devised for entirely different purposes. As a direct source of supply in the delicate tubal patency test it seems to be unwieldy and cumbersome.

The above considerations are not merely theoretical or personal; Furniss, Dickinson, Heaney and others have recognized the same difficulties, and have sought means to simplify the test by eliminating the high pressure tank.

It occurred to me that since the volume of gas needed is small the requisite quantity could be conveniently handled in a bottle under atmospheric pressure. The gas could be forced out of such a container by displacing it, under controlled pressure, with water saturated with carbon dioxide.



The only special equipment required for the method above referred to, consists of two 1 liter bottles with glass and rubber tubing connections. One of these bottles is filled with carbon dioxide gas, and the other with carbonated water (ordinary "soda water"). This very simple equipment can be easily assembled by a druggist, a clinical laboratory, or by the physician himself.

A readily available source of carbon dioxide is the common "soda fountain." From this supply the gas can be conveniently obtained as follows:

One of the bottles, equipped with the glass and rubber tubing, is filled with water and connected through its short tube with the nozzle of the soda fountain. The highly charged carbonic acid water is allowed to escape into the bottle until nearly all of the water is displaced by the gas. The carbon dioxide can be similarly obtained from a high pressure gas tank.

For the actual performance of the test the bottles, properly filled, are connected. A sphygmomanometer is attached to the bottle of water through a T tube, and a Keyes-Ultzman cannula is connected to the bottle of carbon dioxide, as shown in the figure. The tube leading to the cannula is clamped off, and the apparatus is tested for air-tightness by pumping air into the bottle of water with the rubber bulb, up to a pressure of 200 mm. If found satisfactory the apparatus is now ready for the insufflation.

Under the usual aseptic precautions the tip of the cannula is introduced into the cervix. The carbon dioxide is forced into the uterus by pumping air into the bottle of water. The pressure exerted is shown by the sphygmomanometer and the volume of gas introduced is indicated by the fluid level in the bottles. The rate of flow can be easily controlled by varying the pressure.

The interpretations are essentially the same as in the original Rubin test.

1009 MEDICO-DENTAL BUILDING.

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## A NEW STITCHING DEVICE

BY BASIL THOMPSON, M.D., C.M., TUCSON, ARIZONA

**N**OTWITHSTANDING structural improvement in needle holders, the suturing of traumatic and incisional wounds is still one of the most tedious and tiring processes in surgery.

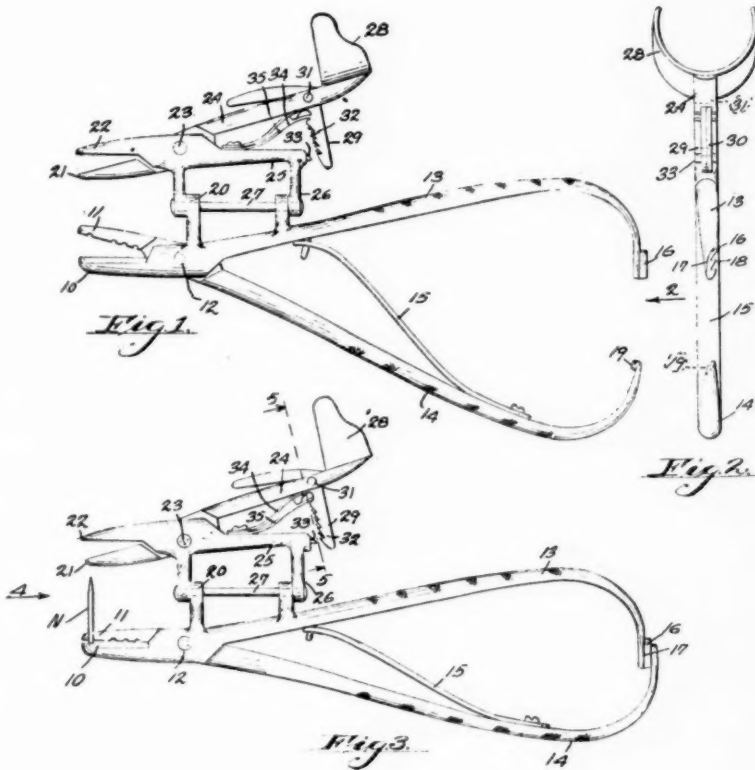
The object of the suturing device, designed by myself, is to facilitate and accelerate the closing of wounds.

My invention relates to improvements in forceps for holding and manipulating surgical curve needles; a device consisting of two pair of surgical needle holders hinged together through their long plane as shown in Figs. 1, 2, and 3, and so con-

structed that the main forceps may be compressed in the fingers of the hand while the auxiliary shorter forceps may be compressed between the thumb and the palm of the same hand.

A curved needle of the proper dimensions may be inserted into tissues with the main forceps, following which the point of the needle is grasped by the jaws of the shorter auxiliary forceps, the jaws of the main forceps are released, and the needle is drawn through the tissues by the auxiliary forceps, thus completing the stitch.

Certain advantages of this suturing device are apparent; the mechanics of suturing may be accomplished with one hand, so that the other hand is available



for sponging or other necessary acts, and an assistant is unnecessary for rapid operative work; second, in stitching with the needle holder, the needle is always held in the jaws of one of the forceps constituting the device, and is never free in the tissues, but is always under the control of the operator; third, in cavity work as during cervical repair where only sufficient field exists for one instrument to be used, this device itself completes the manipulations of stitching without its removal from the cavity, with a consequent saving in operating time. Instruments especially adapted to perineal, abdominal, ophthalmic, and pharyngeal uses, have been designed for these branches of surgery.

706 CONSOLIDATED BANK BUILDING.

## Society Transactions

### CHICAGO GYNECOLOGICAL SOCIETY

MEETING OF JUNE 20, 1930

DR. CARL P. BAUER read a paper entitled, **Thymophysin in Selected Cases of Uterine Inertia**. (See page 411, March, 1931, issue.)

#### ABSTRACT OF DISCUSSION

DR. J. P. GREENHILL.—Dr. Bauer referred to the adverse criticism of thymophysin which was made by Dr. DeLee and myself in the last *Year Book of Obstetrics*. That particular comment was made by Dr. DeLee himself. I do not personally feel so condemnatory of thymophysin as Dr. DeLee does. Dr. DeLee bases his opinion upon a small personal experience with the drug and chiefly upon the view that thymus extract has no effect upon the uterus. If the latter is true, then Dr. DeLee is correct in assuming that thymophysin is nothing but pituitrin. However, Temesvary and two Swiss observers, Mueller and Del Campo claim to have demonstrated conclusively that thymus does have an effect on uterine muscle. I saw Dr. Temesvary in Vienna a few weeks ago and we discussed the use of thymophysin at great length because Dr. Temesvary was greatly disturbed by Dr. DeLee's condemnation which had been published in the *Journal of the American Medical Association*. Dr. Temesvary has statistics from many clinics concerning the use of thymophysin in thousands of cases without apparent harmful effects. The only adverse report I have seen in the literature is a case of rupture of the uterus. However, the author did not believe that the drug was entirely responsible for the rupture.

My own feeling about the use of thymophysin is as follows:

The drug should not be used for the induction of labor because it is generally useless. It should not be used during the expulsion or second stage because it may produce harm. The only indication I can see for its use is during the first stage of labor, namely the period of dilatation and only where a definite indication exists. By a definite indication I mean weak, irregular, or infrequent uterine contractions with little or no progress. I do not believe the drug should be given indiscriminately simply to shorten labor. Furthermore, in spite of the fact that Temesvary and others recommend whole cubic centimeter doses I have never given more than 3 minims at a time and I prefer to repeat this dose a number of times rather than give one large dose. In the third stage of labor, pituitrin is more effective than thymophysin.

DR. E. D. ALLEN.—I have seen two patients develop tetany in the second stage of labor so that they had to be delivered rapidly when the uterus went into tetanic contraction. Both babies were in poor condition when delivered. I would hesitate about giving this preparation in the first stage, before dilatation was complete. It seems to me on the basis of the atrophy of the thymus, that it would be rather surprising to have an effect on the uterus from a gland which undergoes atrophy in adult life.

DR. E. W. FISCHMANN.—We have used thymophysin in over 50 cases, mostly in the first stage, in both primi- and multiparae, with the result that labor pains were augmented somewhat with slight increase in frequency. In two or three cases, we have used it in the second stage of labor, and have seen no untoward results.

We have found it useful in cases in which we tried to induce labor by quinine and castor oil, where slight pains were set up which produced but little dilatation. After thymophysin was given, these slight pains became augmented, increased in frequency and in no case have we failed to secure complete dilatation. It has been our practice to use one-half ampule of thymophysin, and then if the fetal heart tones were good and rhythm not disturbed, the patient was given another ampule within an hour or an hour and a half. Very few cases required more than the half ampule. In our cases, we have seen no untoward results. We have seen no cases of tetany, no asphyxiation in the infant, and so far as we can see the preparation has worked admirably well in our cases and we hope it will continue.

DR. W. H. RUBOVITS.—If the term thymophysin were discontinued entirely in this paper, and in its stead were substituted the words pituitary extract, posterior lobe, everything that has been said might apply almost exactly. It is a discussion much as we indulged in long before thymophysin was heard of. I have had a rather interesting experience with these extracts. A couple of decades ago I was supplied with extract of posterior lobe, at which time we were instructed to administer this drug in 1 c.c. doses. I recall with a great deal of horror some things that happened. In one case the patient was sitting in a chair, in the first stage of labor. Within a few minutes after the injection the abdomen became board-like and the patient died. I delivered a live baby from a dead mother. In another case a multipara went very rapidly into the second stage of labor. She had merely a whiff of ether. She received  $\frac{1}{2}$  c.c. of pituitrin in the third stage of labor. When I went in to see her she said, "I am going to die," and in a few moments she did die. An autopsy was obtained and the cause of death was not determined, and I cannot say definitely that the posterior pituitary extract had anything to do with the death.

DR. N. S. HEANEY.—Dr. Bauer selected his cases because he wanted no confusion to exist as to the effect of his agent. The point brought out was that he gave thymophysin only when he was certain he had a primary inertia with the results that he has noted. Any remedy injected into the individual to produce uterine contractions cannot be expected to inaugurate rhythmic and regular contractions simulating labor pains, if the medium itself is the thing which brings about the uterine contractions. If at some time something is developed which will stir up the motivation in the individual gradually, and thus produce uterine contractions, we may then expect to get regular uterine rhythm. But when we inject one dose of a medium which will produce marked contractions of the uterus, we cannot expect it to act physiologically. We have had now our second introduction to a remedy which was said to be free of all difficulties. When pituitrin was introduced, it was said labor pains would be normal, and many papers were written substantiating the claims. So it is with this preparation, and we must accept other remedies in the future with skepticism.

DR. E. L. CORNELL.—I would like to issue a word of warning about this combination of drugs. It was supplied to me at the County Hospital and on a few of my private patients at the Lying-In Hospital. As Dr. Rubovits said, it puts one in mind of pituitary extract. The directions on the package called for 1 c.c. for the initial dose. I used  $\frac{1}{2}$  c.c. on the first patient and the pains were terrific. The patient yelled considerably and it necessitated the use of anesthesia to control the pains. Meconium appeared and the patient was not ready for delivery. When we started, she had about 5 or 6 cm. dilatation. We had to use gas throughout. She delivered in an hour and a half. In about the third or fourth case there were tetanic contractions of the uterus. The contraction lasted five minutes, when we put the patient to sleep under ether. Meconium appeared in the liquor, and I thought we were going to lose the baby. Lately I have been using it intranasally

in patients who had weak pains and no progress. The effect is usually just as good with the added advantage that you can withdraw the drug easily. Personally, I cannot see any difference between pituitrin and thymophysin.

DR. BAUER (closing).—I cannot answer the question about histamine. The reason for the publication of this paper is to report our experiences with thymophysin since our results are so different from those reported in the recent publication appearing in the *AMERICAN JOURNAL OF OBSTETRICS AND GYNECOLOGY*. We feel that thymophysin, like pituitrin, is seldom indicated in the first and second stages of labor and might be used to control hemorrhage in the third stage of labor.

DRS. R. D. TEMPLETON, IRVING STEIN AND SYDNEY SCHOCHET presented a paper entitled, **Studies in the Physiology and Pharmacology of the Human Vagina.\***

On examining the literature of the physiologic studies of the vaginal contractions it will be found that all the studies thus far have been made on laboratory animals. In a critical and exhaustive review of the literature on the motor activities of the vagina no references were found to physiologic or pharmacologic studies in the human species.

In this paper we present the results of a study of the vaginae in situ of 7 multiparous nonpregnant women. In 2 of the patients, tracings of vaginal contractions were made every second or third day throughout a menstrual cycle. Three of the patients were in the second decade, 2 in the third decade, and two past the menopause.

All of the experiments were carried out in the Mandel Clinic of the Michael Reese Hospital. The patients were placed in one of the quiet clinic rooms, the apparatus (kymograph and drum) shielded from the patients' view and they were permitted to be alone in the room. By this means external stimuli, which might alter the rate or character of the vaginal contractions were largely excluded.

The vaginal balloons were devised by one of us (Templeton) and consists of a condom divided into three compartments, arranged in tandem with a central core. Each balloon has a separate lead (rubber tube) which permits a tracing from each compartment on the kymograph drum. Each compartment was filled with air but not to the extent to distend or stimulate the vagina. Balloon number one was placed next to the cervix so that the third balloon was just within the introitus. All tracings were of two- to four-hour periods so as to eliminate the immediate possible stimulus effect of the introduction of the balloons.

#### DATA FROM NORMAL ADULT FEMALES

1. *Normal*.—All the patients studied exhibited spontaneous and rhythmic vaginal contractions. These contractions occurred every eight or ten minutes and originate in the upper end (cervical) of the vagina, and pass downward to the introitus. There are no differences in the rate of contractions in different parts of the vagina, but those near the introitus are of a lower amplitude. The contractions originate either in the vagina or uterus, and cannot be induced from stimulations in adjacent organs (bladder).

This method does not lend itself to the study of patients before the age of puberty. In women past the menopause the rhythmic contractions were absent. For the present we are reserving our studies of vaginal tracings during pregnancy, since this phase of the work is not completed.

\*From the Laboratory of Physiology, University of Chicago, the Division of Gynecology and Obstetrics, Michael Reese Hospital, and the Nelson Morris Institute of Medical Research.

Complete paper will appear in the *American Journal of Physiology*.



Drugs: Hypodermic injections of 0.6 c.c. pituitrin and ergotoxin cause immediate response of the vagina (increase in the rate and amplitude) with but slight change in the tone.

#### INFLUENCE OF EMOTIONAL STATES ON VAGINAL CONTRACTIONS

Studies of vaginal contractions may be of practical value in the group of gynecologic patients who complain of vaginismus and frigidity, and for the physiologic studies of the vagina during pregnancy and labor.

#### SUMMARY

1. Spontaneous rhythmic contractions are present in the vagina of adult human females during the childbearing period and are absent in those past the menopause.
2. The rhythmic contractions are more marked during the week after the menstrual period (postmenstrual).
3. Vaginal contractions are not induced by contractions of an adjacent organ (bladder).
4. Pituitrin and ergotoxin cause increase in rate and amplitude of the vaginal contractions.

#### ABSTRACT OF DISCUSSION

DR. N. S. HEANEY.—There has been much said regarding the possible effects of operations disturbing the rhythmic contractions of the vagina. How has the effect of rhythmic contractions of the rectum been ruled out in these studies?

DR. SCHOCHET.—The purpose and object of presenting this type of work was the express purpose of emphasizing physiologic studies rather than the study of pathology. If more studies were carried out on the physiologic function of the generative organs, it might throw more light on the effects of surgery on the organs. These studies will lend themselves to two or three types of lesion in the generative tract, especially that group of women who come with so-called frigidity. We could determine whether they really are frigid. In checking up certain female hormones in animal work there is no indication that any drug has anything to do with increasing this function. In drawing conclusions as to the effects of a drug, we are either dealing with an elusive drug or with a psychic effect. The second group of lesions is that group with vaginismus. It may give us a means to localize the point of increased stimulation, whether it is due to nervous stimulation or a lesion in some part of the canal. The third reason is to see whether our so-called mechanical repairs are really repairing the vagina. We try to produce a condition which does not exist in the normal. The question is, how much vaginal repair are we doing? The chief repair or operation in which you want to establish physiologic function would be building up the perineal floor. That puts particular stress on the fascia of the vagina. Answering Dr. Heaney, the fact that the character of the contractions in the rectum is quite different would answer his argument. You do not have similar rhythmic contractions in the rectum.

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#### Errata

In Dr. Cornell's discussion of the Symposium on *The Hemorrhages of Pregnancy*, page 427, April issue, the last word in the third paragraph should be "decreased" instead of "increased."

In the Case Reports of "Acute Puerperal Uterine Inversion," by Dr. Leonard C. Hamblock, in the March issue, page 435, in the second case report, twenty-first line of the first paragraph, the sentence "Episiotomy was required on seventh day, etc.," should read "Episiotomy was repaired on seventh day, etc."

# Department of Reviews and Abstracts

CONDUCTED BY HUGO EHRENFEST, M.D., ASSOCIATE EDITOR

## Selected Abstracts

### Anesthesia

**Fermo, Cesare de:** Experimental Studies on Anesthesia. *Arch. ital. di chir.* 25: 356, 1930.

Experiments performed by the author showed that all the anesthetics tested cause an alteration of the sugar-regulating mechanism in the sense of greater sugar contents in the blood. The intensity and duration of such alterations, however, varied with the different anesthetics. With ether the change was rapid and intense during narcosis, reaching a value of 0.4 per cent to 0.8 per cent over the initial figure. There again is prompt lowering of the glycemia after the anesthesia is stopped, reaching 0.2 per cent to 0.35 per cent over normal. In 5 to 12 hours after anesthesia the blood sugar was again normal.

With novocaine the disturbance was brief, never going above 0.18 per cent to 0.23 per cent over normal.

The question of the cause of postanesthetic hyperglycemia is even now quite obscure in spite of many theories formulated.

SYDNEY S. SHOCHET.

JULIUS E. LACKNER.

**Paroli:** Viscero-Cutaneous Pain in Gynecology and Obstetrics and its Relief by Local Subcutaneous Anesthesia. *Boll. d. Soc. Med. Chir. Bresciana*, No. 1, 1929.

With 0.5 per cent solution of novocaine, the amount varying with the intensity of the pain, injected subcutaneously around a painful zone, excellent results were obtained in such cases as ovarian tumors, carcinoma of the cervix, etc. The pain disappeared for six to eight hours. No after-effects were ever met even with the use of large doses.

In women in labor, where cutaneous reflex pain was noted in the suprapubic abdominal, the lumbo-sacral and perineal zones, injections of novocaine around these zones resulted in complete relief in the first two areas, while no effect was obtained in the perineal zone.

This leads the author to think that in the cases in which this anesthesia yields a good effect the pain from the uterus is transmitted to the posterior horn of the medulla by the vegetative system and then passes to the skin, thus permitting subcutaneous anesthetization.

SYDNEY S. SHOCHET.

JULIUS E. LACKNER.

**Arcieri:** Anesthesia of the Frankenhäuser Ganglion and of the Internal Pudendal Nerve in Gynecology. *Ann. di obst.* 52: 176, 1930.

Anesthesia of the ganglion of Frankenhäuser and of the internal pudendal nerve, obtained with a 1 per cent solution of novocaine, is sufficient for all operations

that might be performed on cervix, vagina, and perineum. The technic of injection is simple and the results are good.

SYDNEY S. SHOCHET.  
JULIUS E. LACKNER.

Halban, J.: **The Control of Pain in Obstetrics and Gynecology.** Wien. klin. Wchnschr. 42: 682, 1929.

Pain associated with conditions in the pelvis may be divided into: (a) pain during operative procedures; (b) during labor; (c) in gynecologic diseases.

During operative procedures the modern tendency is to use local anesthesia rather than general. Good results are obtained and 0.2 per cent tutocain is the ideal anesthetic.

In obstetrics "narcose a la reine," sedatives during the first stage of labor, and scopolamin-morphine are recommended. Results with Gwathmey anesthesia have varied, so that its use is still debated. The avertin method, together with Martin's modification using scopolamin and narcophin, is still too recent and the results too divergent to permit its recommendation for general use. Anesthesia produced by the intravenous injection of somnifen and pernokton has been satisfactory but the efficacy of these substances is still uncertain. The author has used pernokton, 1 c.c. per 12.5 kg. body weight, slowly injected intravenously, and finds that results have been good. The anesthesia lasts 1 hour. Occasionally there have been periods of wild excitement following injection. Spinal, sacral, and pudendal anesthesia are uncertain, and hypnosis too highly specialized. The best and simplest method is the "narcose a la reine," or the use of small quantities of ether with pains.

In gynecologic diseases the method used to control pain depends upon the condition. For inflammations, rest in bed and heat or cold are used. Heat may be in the form of hot air, diathermy, douches, thermophor, pelvitherm, gynotherm, etc. Diathermy is especially efficacious. Medications such as the antineuralgics, atropin, and the opiates are helpful. In backache, diagnosis is of primary importance followed by correct therapy. Paravertebral anesthesia to control pain has shown good results. This depends upon breaking the viscerosensory arc by injection of the nervus communicans between the ganglion and spinal cord. The arc may also be broken by injections around the Head zones. The author has used this method and his results have been surprisingly good. He recommends it highly.

FRANK SPIELMAN.

Heim, K.: **Local Anesthesia in Obstetrics and Gynecology.** Monatschr. f. Geburtsh. u. Gynäk. 84: 45, 1930.

The author believes that local anesthesia has proved its usefulness in obstetrics and gynecology. He prefers lumbar anesthesia for abdominal operations and parasacral anesthesia for vaginal work. Other forms of local anesthesia such as the intravenous use of avertin and the use of perkain are likewise helpful. In perineal and minor vaginal operations, direct infiltration is sufficient.

Direct infiltration of the abdominal wall for the performance of cesarean sections deserves more attention than it has hitherto received. It may also be used for cases of adnexal inflammation where there are not many adhesions.

J. P. GREENHILL.

Oku, M.: **Pudendal Anesthesia in the Domain of Obstetrics.** Japanese J. Obst. & Gynec. 12: 361, 1929.

Oku employed pudendal anesthesia by the method of Gellert, Schmidt and Pribram in 100 cases and he believes that procedure is simple and harmless. It

removes all the pain associated with the second stage of labor. The muscles of the pelvic floor are completely relaxed and the second stage is frequently shortened. The number of episiotomies and perineal lacerations is diminished. If suturing is necessary, it is a painless procedure. This form of anesthesia permits forceps operations and breech extractions without producing pain. No disturbance in labor pains, placental separation, or contraction of the uterus is observed. Except for purulent inflammation at the points of injection and their neighborhood, there are no contraindications to this form of anesthesia.

J. P. GREENHILL.

**Oku, M.: Painless Labor by Local Anesthesia.** Japanese J. Obst. & Gynec. 12: 358, 1929.

The author used local anesthesia in the parametria by direct infiltration after the method of Gellert in 33 deliveries. The greatest defect in the type of paracervical anesthesia which he used was the shortness of its duration. Hence it is not very helpful for relieving pain in the first stage of labor. If given in the second stage, pain was eliminated in part or entirely in 80.7 per cent of the cases. The results were better in multiparas than in primiparas. Gellert and Pribram maintain that a large dose of pituitrin entails no risk when combined with the local anesthesia in the first stage of labor but Oku disagrees with this statement. However, he has seen no harm from the local anesthesia itself.

J. P. GREENHILL.

**Cosgrove: Spinal Anesthesia in Obstetrics.** Am. Jour. Surg. 5: 602, 1928.

Cosgrove extends the usefulness of spinal anesthesia in obstetrics by eliminating possible drawbacks through refinement in technic. Extreme lowering of blood pressure is guarded against by the administration of ephedrine ten minutes before injecting the novocaine. Fifty mg. of crystallized novocaine dissolved in 2.5 c.c. of spinal fluid are injected into the fourth lumbar space for obstetric vaginal operations and 100 mg. in the third lumbar space for obstetric laparotomies. Vomiting, depression, and headaches are less frequently observed and only one case in a series of four hundred had a persistent paresthesia. The advantages pointed out as of general application are enhanced in the hepatic and renal toxemias.

WILLIAM KERWIN.

**Gautret: Three Cases of Rapid Labor Under Spinal Anesthesia.** Bull. Soc. d'obst. et de Gynéc. 18: 215, 1929.

Three cases in which rapid dilatation of the cervix and quick delivery were performed under spinal anesthesia are detailed by the author. One patient was in labor at the time of the operation. In two cases delivery was accomplished in 20 and 25 minutes respectively. Lacerations of the cervix and perineum occurred in two cases.

J. P. GREENHILL.

**Faugère: Artificial Dilatation Under Spinal Anesthesia.** Bull. Soc. d'obst. et de Gynéc. 18: 199, 1929.

The author reports two cases and concludes that dilatation of the cervix under spinal anesthesia can easily and rapidly be performed. Version is not interfered with by uterine contractions and the author believes this form of anesthesia is superior to general anesthesia, especially chloroform, in serious cases.

J. P. GREENHILL.

**Audebert and Estienny: The Action of Spinal Anesthesia on the Perineum of Parturient Women.** Bull. d. Soc. d'obst. et de Gynéc. 18: 98, 1929.

It is generally conceded that spinal anesthesia exerts a softening action on the perineum. This action is definite but it is not constant. Occasionally it does not prevent extensive perineal lacerations and not infrequently an episiotomy must be performed to avoid injury. According to the authors, the action of lumbar anesthesia depends on the anatomic condition of the individual perineum. They report 30 observations in which they employed this type of anesthesia for performing breech extractions, forceps operations, and pubiotomy. In cases of forceps delivery, spinal anesthesia gives good results, in cases of breech extraction the perineum is in great danger of being lacerated and spinal anesthesia is the physiologic complement of pubiotomy for which it permits an extension of indications.

J. P. GREENHILL.

**Pistuddi: Forced and Accelerated Parturition in Spinal Anesthesia With Special Reference to the Method of Delmas.** Arch. Ostet. e Ginec. 17: 408, 1930.

The author after an accurate evaluation of the statistics of many authors and of his own personal experiences makes the following conclusions: It is true that in forced parturition or in attempts to accelerate labor and to hasten dilatation of the cervix, it is useful to protect the cervix from every reflex action, but to obtain this a spinal anesthesia is not necessary. A general narcosis will do just as well when sufficiently deep.

The author believes that spinal anesthesia may be given preference to general narcosis especially in cases of hypercinesia and when it is desirable to influence the uterine retraction and contraction.

The author believes it would be better from now on, to speak of rachianesthesia and not of the method of Delmas.

SYDNEY S. SHOCHET.

JULIUS E. LACKNER.

**Metzger: Some Observations of Dystocia Labor Under Spinal Anesthesia.** Rev. Franç. de Gynéc. et d'obst. 24: 14, 1929.

Metzger has always felt that labor at a fixed hour was not a proper thing and his experience with this procedure in several cases of dystocia has justified his opinion. Among five cases, one patient died of hemorrhage. The author admits that spinal anesthesia produces relaxation of the perineum but he maintains that the same is not true of the body of the uterus or the cervix. He has always held that dilatation of the cervix in a uterus which is at rest is impossible. Spinal anesthesia produces not a relaxation but a hypertonicity of the body of the uterus. If the uterus is normal and soft the cervix may be dilated rapidly but if the cervix is rigid, persistence in manual dilatation may result in rupture of the uterus. Hypertonicity of the uterus manifests itself when attempts at version or forceps delivery are made. Furthermore, when a cesarean section is performed under spinal anesthesia, the uterus is contracted and there is little bleeding. The author experienced difficulty in all five cases in which he tried the Delmas procedure.

J. P. GREENHILL.

**Tassovatz, S.: Spinal Anesthesia for the Low Cesarean Section.** Rev. Franç. de Gynéc. et Obst. 24: 350, 1929.

At the Woman's Clinic in Strasbourg, 56 low cervical cesarean sections were performed under spinal anesthesia. In only two cases was there complete failure of



the anesthetic and in 50 cases the results were very good. In all of these cases the uterus was found to be well contracted when the abdomen was opened. The extraction of the child was easy and in 17 cases, the placenta separated spontaneously. The children cried immediately after birth. The postoperative recovery was smooth.

J. P. GREENHILL.

**Edwards, George:** Avertin Narcosis. Brit. Med. Jour. 2: 213, 1929.

The merits of avertin narcosis for operations are those of rectal anesthesia combined with those of deep preliminary and subsequent narcosis.

The dosage where there is no marked weakness or general infection is 0.1 gm. per kilo of body weight. Doses of 0.125 gm. and 0.15 gm. occasionally give trouble. The total dose is from 6 to 8 gm. The drug is provided in a concentrated solution with amylene hydrate, 1 gm. in 1 c.c.

Small quantities of inhalation anesthetics are usually necessary and it requires an experienced anesthetist to control the superimposed anesthesia. The amount of ether and chloroform used will be measured in drachms rather than ounces. The duration of the narcosis is from 1½ to 2 hours from the time of injection. Four hours from the start the patient is usually quite conscious of her surroundings.

When return to consciousness is prolonged the treatment consists of injections of lobeline, administration of CO<sub>2</sub> and O<sub>2</sub> mixtures and injections of ephedrine. During both the period of induction and that of recovery the relaxed jaw and tongue should be watched.

Avertin is contraindicated in diseases of the kidney, liver, colon, and where there is thyroid deficiency. It is excreted almost entirely by the liver and kidneys.

Morphine should not be used prior to injection.

During narcosis there is a fall in blood pressure of 10-20 mm. as occurs in deep sleep. There are no definite changes in the pulse rate. Breathing is shallow and the rate normal or slightly quickened. A slight cyanosis is usually observed.

G. E. HUDSON.

**Naujoks:** The Value of Avertin. Monatschr. f. Geburtsh. u. Gynäk. 84: 97, 1930.

The author does not believe that all the fatalities recorded as avertin deaths in the literature because they followed avertin anesthesia were due to this drug. Many of the deaths if not due to excessive doses or faulty technic were caused by defective constitution.

In obstetrics, avertin produces painless labor at the end of the first stage and during the second stage. It is the best narcotic for patients with eclampsia and is better than the Stroganoff treatment for this complication.

J. P. GREENHILL.

**Connell, J. S. M.:** The Use of Avertin in Childbirth. The Lancet 2: 184, 1930.

Avertin may be used in every case where antenatal examination indicates normal parturition, except when the presenting part is on the perineum. It may be used also while preparing for operative interference. Its usefulness is increased in primiparas. Avertin does not produce painless labor but it makes "things so easy for the patient."

The author encourages the general practitioner to give this analgesic agent a trial. This preparation is easily given, requires little apparatus, has no "after-results," and is reasonably safe, although not entirely "foolproof."

H. C. HESSELTINE.

**Fairbairn: Sedatives in Labor, Particularly "Twilight Sleep."** Brit. Med. Jour. 1: 753, 1929.

The great number of labors which terminate in operative deliveries could be reduced materially by alleviation of the fatigue of mind and body. The author uses morphine gr.  $\frac{1}{4}$  to  $\frac{1}{2}$  with hyoscine  $\frac{1}{150}$  in patients where the labor pains are well established and are causing a great deal of discomfort. He does not hesitate to use these drugs up to the time of complete dilatation of the cervix. If the second stage is not terminated promptly he recommends  $\frac{1}{2}$  cm. of pituitrin intramuscularly to be followed by low forceps in the event of failure of spontaneous delivery. The so-called "twilight sleep" or morphine-hyoscine narcosis is recommended for some cases to produce amnesia. An initial dose of morphine gr.  $\frac{1}{4}$  and hyoscine gr.  $\frac{1}{150}$  is given and the hyoscine in  $\frac{1}{450}$  grain doses is repeated at frequent intervals until the amnesia is obtained. The narcotized baby which often results is not a cause for worry.

M. EDWARD DAVIS.

**Jennings, David R.: Hyoscine Amnesia in Labor.** Brit. Med. Jour. 2: 801, 1929.

This is a record of 24 cases treated by hyoscine alone, throughout the first and second stages of labor. It consists in giving  $\frac{1}{100}$  gr. of hyoscine as soon as labor is fairly started. Thereafter two more  $\frac{1}{100}$  gr. at half hourly intervals followed by similar injections of  $\frac{1}{100}$  gr. every two hours as long as labor lasts.

The effect of the drug becomes moderately noticeable after the second half-hourly injection. There is a sharper distinction between the actual pains and the period of quiescence. The former is characterized by a period of restlessness, while the latter is spent in quiet sleep. There is a slight cyanotic flush which is more noticeable during a pain. The pupils become dilated and the lips and tongue dry. The voice is rarely raised above a moan or subdued muttering. The memory test is usually lost after the third injection, and remains so until the end of labor. Loss of recognition test, of an object such as a pen may occur, but unless this happens early or the condition is associated with deep unconsciousness and stertorous respirations the hyoscine should be continued. Should the pains weaken, the next injection should be deferred until they are again satisfactory. Catheterization may be necessary. Large patients may require restraints. Two patients in this series showed hallucinations after the delivery of the placenta. None were found intolerant of the drug.

Complete amnesia was obtained in 20 cases and the incidents remembered by the remaining four were few.

All babies were born alive. The third stage was normal in all cases, average duration being 15 minutes 12 seconds, and loss of blood about  $5\frac{2}{3}$  oz.

G. E. HUDSON.

**Gwathmey, James T.: Obstetrical Analgesia.** Surg. Gynec. & Obst. 51: 190, 1930.

Inasmuch as "Obstetrical Analgesia" never reaches full surgical anesthesia, and was employed by the inexperienced during the period of its development, there is no good reason why it should not continue to be used by them as well as by the expert obstetrician. If mistakes are made no harm can result to either mother or child. It simply alleviates the pains of childbirth, with no increase in stillbirths, and with no interference in any way with the normal processes of labor.

The medication varies in its results from a light sedative effect to analgesia with unconsciousness and amnesia. The progress of labor is not delayed. Oc-

cipitoposterior positions rotate in about the same proportion as in normal labor. Postpartum hemorrhage is less than with any inhalation method. If anything, the use of forceps is decreased. Statistics show that the incidence of forceps delivery has been reduced over 50 per cent since the method has been used.

Increased success will come with experience. Those who take the trouble to explain to the patient and thus secure her cooperation will obtain better results than those who administer drugs in a mechanical manner.

The standard method consists of three intramuscular injections of magnesium sulphate, each of 2 cubic centimeters of a 50 per cent solution, an injection of morphine sulphate,  $\frac{1}{4}$  grain given with the first injection of magnesium sulphate only and a rectal instillation of a solution consisting of:

Quinine alkaloid	gr. 20
Alcohol	min. 40
Ether	oz. $2\frac{1}{2}$
Petrolatum liquid or olive oil q.s.ad.	oz. 4

In prolonged labor this complete technic in many cases may be repeated twice and occasionally three times without detriment to either mother or child.

WILLIAM C. HENSKE.

## Books Received

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TEXTBOOK ON THE NURSING AND DISEASES OF SICK CHILDREN for Nurses and Welfare Workers. Edited by Alan Monerieff, medical registrar and pathologist to Hospital for Sick Children, London. With 111 illustrations. New York, G. P. Putnam's Sons, 1930.

LECTURES UPON THE NURSING OF INFECTIOUS DISEASES. By F. J. Woollacott, senior assistant medical officer, Grove Hospital, London. New York, G. P. Putnam's Sons, 1930.

TEXTBOOK OF ORTHOPAEDIC NURSING. By Evelyn C. Pearce. New York, G. P. Putnam's Sons, 1930.

GYNAECOLOGY FOR NURSES AND GYNAECOLOGICAL NURSING. By Comyns Berkeley, gynecological and obstetric surgeon to Middlesex Hospital, etc., etc. Revised and enlarged edition. G. P. Putnam's Sons, New York, 1930.

ABDOMINO-PELVIC DIAGNOSIS IN WOMEN. By Arthur John Walscheid, director of obstetrical and gynecological department of Broad Street Hospital, etc., etc. With 397 illustrations and one color plate. St. Louis, C. V. Mosby Company, 1931.

AN INTRODUCTION TO GYNECOLOGY. By C. Jeff Miller, professor of gynecology, Tulane University School of Medicine, etc., etc. Illustrated. St. Louis, C. V. Mosby Company, 1931.

CANCER. Its Origin, Its Development, and Its Self-Perpetuation. A research by Willy Meyer, consulting surgeon of the Lenox Hill and Postgraduate Hospital, New York, etc., etc. New York, Paul Hoeber, Inc., 1931.

DAS GYNAEKOLOGISCHE SEMINAR. Praktische Gynaekologie in 15 Vorlesungen. Dr. Wilhelm Liepmann, Universitaetsprofessor, Direktor des Deutschen Instituts fuer Frauenkunde, etc. Mit 305 zum Teil mehrfarbigen Abbildungen im Text und auf 24 Tafeln. Urban & Schwarzenberg, Berlin und Wien, 1931.

GYNAEKOLOGISCH-GEBURTSHILFLICHE TASCHENHEFTE fuer den praktischen Arzt. Von San. Rat Dr. Karl Abel, Berlin. Verlag von Otto Enslin, Berlin, 1931.

PHYSICIAN'S MANUAL OF BIRTH CONTROL. By Antoinette F. Konikow, M. D. Buchholz Publishing Co. New York.

OPERATIVE OBSTETRICS ON THE MANNIKIN. By Charles B. Reed, associate professor of obstetrics, Northwestern University Medical School, Chicago, etc., etc. With 254 illustrations. Philadelphia, P. Blakiston's Son & Co.

LES DIAGNOSTICS ANATOMO-CLINIQUES DE P. LECÈNE. Généralités par P. Pavie. Lésions du Sein, par P. Moulanguet. Masson et Cie, éditeurs. Paris, 1930.

## Item

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### American Board of Obstetrics and Gynecology

The following names have been added to the list of Certificate holders published in the April issue:

BACON, C. S.	BROOKLYN, N. Y.
CULBERTSON, CARY	CHICAGO, ILL.
KANE, H. F.	WASHINGTON, D. C.
SMITH, W. S.	BROOKLYN, N. Y.

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A written examination for Group III applicants, for certification by the American Board of Obstetrics and Gynecology, was held on March 14, 1931, in nineteen different cities in the United States and Canada. The examination paper included the following questions:

1. Describe briefly the anatomy of the pelvic floor.
2. (a) Describe the cyclical changes occurring in the endometrium.  
(b) At what stage in the menstrual cycle should the transuterine insufflation test be done? Why?
3. Describe the autopsy findings in a case of (a) post-partum mixed infection; (b) post-partum pure streptococcus infection.
4. Give a brief outline of prenatal care.
5. Discuss the differential diagnosis of ectopic pregnancy.
6. Discuss the management of labor in the right occipito-posterior position.
7. (a) What is the most common type of (1) cancer of the cervix; (2) cancer of the corpus uteri? Describe each one.  
(b) Which is the more malignant? Why?
8. Discuss radiotherapy versus hysterectomy for (a) cancer of the cervix; (b) cancer of the corpus uteri.
9. Outline the treatment of acute gonorrhea and its complications in the adult female.
10. Describe the technic of an operation for complete prolapse of the uterus.

The practical and oral examinations for all Group III and Group II candidates will be held at the Philadelphia General Hospital, Philadelphia, Pa., on Saturday, June 6, 1931.

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